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FINANCE, AMERICA AND COTTON PRICES

BY

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JUST over four years ago commodities in general and cotton in particular entered upon a long decline which carried the prices of most of the world's staple commodities definitely below cost of production, while many, like rubber, cotton, wheat and silver, have touched new low records. It is impossible here to discuss all the causes of this great fall of prices, and particularly the theory that the general decline of prices was due to a world shortage of money as the result of a reduced gold supply; but looking back over the first stages of the decline, it may now be taken as admitted that the *immediate* cause of the break in prices was the sudden check on consumption in America as the result of the Wall Street crash in October, 1929. This was particularly true of cotton where the record rate of consumption in America during 1926–27 was well maintained until the end of 1929. Then came the great struggle of the American and Egyptian Governments to uphold cotton prices by Government intervention in the markets, which finally collapsed in 1931 with the bumper American crop of that year. Since then first England and then America have gone off the gold standard, the former very unwillingly and the latter deliberately, and the main purpose of this article is to discuss the effects of these later developments, first on the prices of cotton in general, and second on the prices of American cotton as compared with other growths. It so happens that these events fall naturally into periods roughly corresponding with the three cotton seasons, and we shall therefore tabulate this article accordingly.

1931–32

Space forbids any discussion of the events which drove England off the gold standard in September, 1931, but here again it may now be taken as admitted that the original source of the troubles in Austria and Germany, which were the immediate cause of the break-

down of the world's confidence in England, was the cessation of American loans to Germany, which resulted from the New York Stock Exchange boom in 1928–29. The effects of our abandonment of gold on cotton prices must, however, be considered in more detail. The main point is that England's action meant that practically all the major cotton-growing countries of the world, except America, went off the gold standard, for the currencies of India, Egypt, our African colonies, and the West Indies were all linked with sterling and (with some hesitation in the case of India and Egypt) they decided to remain so. The effect of this ought to have been to make American cotton dearer in those cotton-consuming countries which remained on the gold standard, and therefore to divert their consumption from American to cotton grown in the countries of what may be called the sterling bloc, but as it happened the conditions of supply proved so abnormal during 1931–32 that the result was quite otherwise. The enormous 1931 crop in America made the price of American cotton relatively cheap, and during that season the world's consumption of American cotton made a substantial recovery from the low point of the previous season, largely at the expense of Indian and other growths.* As it happened the crops in India and China were very much reduced in 1931–32, which helped to increase the demand for American. Egyptian, however, as the result of the wise decision of the Government to abandon artificial price control, fell even more than American during the first part of the season, which resulted in increased consumption, especially of Uppers, and enabled the Egyptian Government to dispose of a considerable part of their stocks.

The effect of all this on cotton prices may be summed up in the fact that, while Liverpool prices of all varieties touched their lowest point in August-September, 1931, the sharp rise when we went off the gold standard lasted only till February, when a new decline began in line with world prices which had been falling practically all the time. The result was that New York, being the only market still remaining on the gold standard, touched its lowest record in June, 1932, when Liverpool was only saved by our being off the gold standard from another new low record. It is interesting to note here that during that season Tanguis (Peruvian) definitely improved its position as against Sakel, Uppers and East African, while in the same way Pernam (Brazilian) recovered its normal position slightly above American. It was during that season that Indian for a time secured an entirely abnormal position, actually above American, but that, of course, was due to relative crop conditions.

* *See* Table of World's Consumption, IV., on p. 45.

1932–33

The early summer of 1932 was marked by another period of recovery as the result of more hopeful general conditions, but this, unfortunately, again proved short-lived. The Lausanne Agreement, which looked like the beginning of the end of the whole business of Reparations and War Debts, was the signal for a general rise of prices both on the Stock Exchange and in the commodity markets; and it so happened that cotton prices gained an added impetus through the early reports of the coming crop in America indicating a very sharp reduction, which unfortunately was not substantiated as the season advanced. But the consequent relapse in the price of cotton was only one incident in the general relapse of commodities and Stock Exchange securities, which finally resulted in the financial crisis in the United States in the early months of 1933. To explain that crisis it is necessary to go back in the history of the depression in the United States to the winter of 1931–32. Up till then the efforts of the authorities to check the fall in cotton had been confined to the operations of the Federal Farm Relief Board, which proved entirely ineffective to maintain cotton prices against the overwhelming effect of the 1931 crop. Early in 1932, however, the authorities in Washington embarked upon a new policy, popularly described as an attempt by America to "lift herself up by her own boot-straps," the main idea of which was that, as the rest of the world had conspicuously failed to get themselves out of the mess, America must tackle her own domestic situation independently of other countries. The method adopted was the creation of additional credit facilities; and, omitting a long series of preliminary attempts, this finally took form in the setting up of the Reconstruction Finance Corporation with total funds of $2,000 millions, which was intended primarily to liquidate the position of the banks in America, thousands of which had failed, and to set industry on its feet again by providing the necessary credit facilities. During 1932 the position in America had greatly improved. There were comparatively few bank failures, and hoarded currency was being returned to the banks; but by a curious irony of fate it was the Reconstruction Finance Corporation itself which brought about a fresh debacle. Someone insisted on publishing the list of borrowers from the Reconstruction Finance Corporation, and the immediate effect was to destroy confidence in them and to start a fresh run on the banks, which, to cut a long story short, resulted in a national moratorium on March 2, 1933, when Roosevelt was inaugurated as the new President. The gold embargo

which was immediately imposed strictly speaking involved America's departure from the gold standard, but this was not officially admitted until April 19, when a slight change in the method of applying the embargo convinced the world and resulted immediately in a sharp fall of the dollar.

In the meantime the " lame duck " session of Congress, which sat between the Presidential election and the inauguration of the new president, had once more tackled the question of legislative assistance to the farmers, which dates back as far as the McNary-Haugen Bill of 1927. That proposal was now revived along with many others, but the Farm Relief Bill which embodied some of them only passed through Congress two days before Hoover's demission of office and was never signed by him. When Congress reassembled a new Agricultural Relief Bill was introduced, and this, like all the previous proposals, provided for certain benefits to the cotton planters on condition that they reduced their acreage in 1933. But the discussion of this Bill took so long that before it passed Congress in May the crop was sown, with an actual increase in acreage of 11·6 per cent., and the Bill had to be turned into a measure for the abandonment of acreage already planted. The inducements offered to the planters were: (*a*) The right to take up an option on Government cotton acquired between 1929 and 1931, as the result of the operations of the Federal Farm Relief Board, to the extent of the reduction of their 1933 crop, the option price being 6 cents per lb; (*b*) in addition to this, a leasing payment varying from $6 to $12 per acre, according to the average yield of the land involved; or (*c*) if the planter did not choose to take up the option on the cotton, the leasing payment might rise to $20 per acre. In July it was announced that the scheme had met with ample acceptance, the contracts covering an abandonment of about 10,300,000 acres, or 25 per cent. of the acreage planted, and it appeared that about 60 per cent. of the planters had exercised their option to take up the Government cotton, which, as it happened, accounted for just about the amount that the various Government agencies still had in hand, say 2,500,000 bales. The scheme, therefore, came into force on August 1, and as from that date a Processing Tax of 4·2 cents per lb. was imposed on all cotton consumed by the industry in the United States to provide the necessary funds—the payments under the leasing plan alone amounted to $110 millions!

But in the course of its passage through Congress the Agricultural Relief Bill had a new section added to it which conferred upon the President the most extraordinary financial powers, including (1) the

right of the Government to issue \$3,000 millions of bonds to the banks and, if the banks would not take them up, to issue currency for that amount; (2) Provisions for the rehabilitation of silver, *inter alia* by authorizing the acceptance of payment in silver to the extent of \$200 millions from foreign debtors, this silver to be used as the backing of a further issue of silver certificates; (3) Power to the President to reduce the gold value of the dollar to such an extent as he thought fit up to 50 per cent.

Very little actual use was made of these powers, however, probably because the immediate effect of America's going off the gold standard was a sharp rise in cotton prices on the American exchanges —in July, New York futures touched 12 cents—and this was reflected to a certain extent in Liverpool. During the last three months of the season the consumption of cotton in America went up by leaps and bounds, till in June it touched a new record for any month in history. Roosevelt, however, was fully alive to the dangers of a rise of prices unless accompanied by a similar increase in the purchasing power of the nation at large. His next step, therefore, was the setting up of the National Industrial Recovery Administration, which was to put all the major industries of the country in a strait-jacket by Codes reducing their hours of labour, fixing minimum wages, cutting out the employment of juveniles and introducing the principle of collective bargaining, which, of course, has always been anathema to American employers. The effect of this was inevitably a substantial increase in cost of production, and by August considerable misgivings were being generally felt as to whether the increase of pay rolls would be sufficient to cover the rise of retail prices. Roosevelt, therefore, found himself subjected to severe pressure on all hands to introduce direct inflation by expansion of currency, which, however, he was very loath to do, preferring the method of expansion of credit facilities.

1933–34

The next link in the chain of events was the publication on August 8 of a Bureau report which, as the result of an almost incredible yield per acre, placed the prospective crop at 12,314,000 bales, or about 1½ million bales more than anybody had expected, and that figure has since been raised by every subsequent Bureau, until in December it stood at 13,177,000 bales, or just above last year's crop figure! Thus the unwanted bounty of Providence has completely offset all the efforts of the Government to reduce this season's supply. The inevitable result was a continued decline in prices,

and as Roosevelt's avowed policy was directed above all things to the raising of agricultural prices, he found himself forced to adopt further inflationary measures. The first step was on August 29, when it was announced that American producers of gold, instead of being compelled to hand over their output to the Treasury at the old par price of about $20·67 per fine oz., would be paid the world's market price. On October 25 it was announced that the Government would fix the price for American mined gold, and the price fixed for the first day ($31·36) was distinctly above the world price as fixed in the London bullion market. A few days later it was announced that America would also buy gold abroad, presumably at a similar price to that for domestic gold, but neither the price paid nor the amounts purchased were to be disclosed. Thus began the most dramatic development of all, with the sterling-dollar exchange falling rapidly from about $4·60 until, on November 16, it touched $5·56. That apparently gave the authorities in Washington furiously to think, and for a few days they stopped raising the domestic price of gold, which by that time had risen to $33·56. In the meantime the sterling exchange on Paris improved steadily from about 79 fr. on November 2 to over 84 on the 27th, and the London gold price fell accordingly.

Such, then, was the result of America's determination to adopt an independent policy, which had been foreshadowed by the President's pronouncements when he turned down the scheme for temporary stabilization put forward during the meetings of the World Economic Conference. But this latest desperate attempt of the President to raise prices in America had not the same good fortune as his previous efforts. Until October the New York price of cotton had followed the sterling-dollar rate of exchange pretty closely, but when the new spurt of inflation began, not only cotton but Stock Exchange securities and commodity prices in general obstinately refused to follow the upward lead of the depreciated dollar. It would, of course, be out of place here to express any opinion on the merits of the President's financial adventures, even if it were possible at this stage to come to any definite conclusion. All that can be said is that during November opposition in America had become much more vocal, and that the whole issue of the great experiment was hanging in the balance.

Our business is to consider the effects of the change in American conditions on world cotton prices, and particularly on the prices of other kinds of cotton than American. The first effect of the cheapening of the dollar was, of course, to lower cotton prices in Liverpool,

but that is not quite a complete indication of the real movement in the value of cotton. At the same time as the President was inaugurating his new gold policy a further development of the plans for relief to the cotton farmers was introduced. This was a proposal in September to advance to the planters 10 cents per lb. on their holdings of the 1933 crop, and later on this was extended to include the Pool cotton, on which the planters held an option, by advancing to them also 10 cents per lb. against their options, of which 6 cents would go back to the Government against the price payable for the cotton under the option, while the 4 cents would be handed over to the planter. Thus, in effect, a minimum price of 10 cents was set up for cotton, and as the fixed price was based on Low Middling at the warehouses in the interior, it is believed to be equivalent to a futures price for Middling in New York of something over 11 cents. Perhaps the most remarkable feature of the present position is that this has not resulted in establishing 11 cents as the minimum price in the futures market. But the real effect of this minimum price has been to create a holding movement throughout the Belt, as the result of which the "basis," which controls the actual price at which spot cotton can be bought in the Belt, has risen sharply, and it has now become almost impossible to import American cotton into Liverpool because the basis is so high. As it happens, this coincides with a very large prospective crop in Egypt, especially of Uppers, which, of course, compete most directly with the better grades of American cotton, and this has already resulted in very large sales of Uppers cotton in Alexandria. The result has also been to produce a very marked drop in the relative prices of Uppers to Tanguis and also East African. Some indication of these changes will be found in Table VIII., which appears in the writer's usual statistical article on page 47 of this issue.

Another illustration of the complicated reactions of the position in America on other parts of the world is to be found in the anxiety which has recently been evidenced in India. As part of the negotiations at Ottawa we had undertaken to do everything possible to increase the consumption of Indian cotton in Lancashire, but the Indian cotton interests are naturally afraid that the cheapening of the dollar will make American cotton relatively cheaper in Liverpool than Indian, and will therefore counteract any efforts that may be made in Lancashire to fulfil the Ottawa promises. As a matter of fact, however, no effect of this kind can yet be traced, because here again, whatever influence might have been exercised by exchange developments has been outweighed by actual conditions of supply.

It will be remembered that the very small Indian crop of 1931 sent the prices of Indian cotton up to an entirely abnormal level relative to American. The 1932 crop was very little better, and Indian prices remained rather above normal. The prospects of this year's crop in India, though still far below the figures of former good years, are distinctly better, and it was to be expected that the prices of Indian cotton would sag a little. So far, however, as will be seen from Table VIII., there is no sign of anything like an undue fall in the price of Indian cotton in Liverpool.

A much more important development so far as Indian cotton is concerned is the recent boycott by Japan of Indian cotton in retaliation for India's threat of differential tariffs against Japan. That, again, is a matter of the exchanges, because it is the depreciation of the Japanese yen which has enabled them, as manufacturers of cotton goods, to undercut every other producer in almost every market in the world.

A further effect of the depreciation of the dollar will be to make foreign cottons much dearer in America. In the war years and afterwards America's consumption of foreign cottons had increased enormously, especially Egyptian for use in the tyre trade, but the introduction in 1930 of the 7 cents tax on foreign long-staple cotton resulted in a very sharp reduction of the imports, not only of Egyptian but also of other foreign cottons, so that the change now will not make much difference. The tyre trade in America, however, has recently been getting very restive over the tax on Egyptian, of which they still find it necessary to use a certain quantity in tyre fabric, and there has been considerable agitation for the repeal of the tax.

Still another curious illustration of the ramifications of tariffs and exchanges is to be found in the Sea Island trade with regard to the position of Porto Rico and the United States. When America imposed the 7 cents tax Porto Rico cotton entering the United States did not, of course, pay the tax, because from a fiscal point of view Porto Rico is American. But when England went off the gold standard this advantage was discounted by the fact that America could buy Sea Island more cheaply from the British West Indies, because of the depreciation of sterling, and it was probably largely as the result of this that the ginnery in Porto Rico (which was operated by a British concern) has recently been closed down. But now that the dollar is again below par with sterling the situation may be changed again to the disadvantage of the British West Indies, which would be very unfortunate, for they have recently been feeling the benefit of the improved demand for their cotton.

There is only one conclusion to be drawn from the whole business. It is a mad world we are living in today, with tariffs, quotas and exchange restrictions everywhere, and trade prohibitions of all kinds which seem to be rapidly strangling international trade; and the consequences of all this chopping and changing in the world's financial basis — the international gold standard—while they may at times profit one country or another temporarily, are perhaps the most disastrous of all the after effects of the war.

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THE SPINNING VALUE OF COTTON

BY

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It is just ten years since the present writer[1] (1924) contributed to the first volume of the Empire Cotton Growing Review an article with the same title as appears above. In this article were described the various properties required in yarns and the limitations to which spinners were subject in making the yarns at a commercial price. A short account was given of the various processes of spinning to indicate the kind and degree of mechanical action to which the cotton is subjected in them, and the last three paragraphs were devoted to a discussion of the quality of cotton and its determination. It was pointed out that the cotton-grader's valuation of a cotton for spinning purposes was much more liable to subjective errors than a spinning test, especially when applied to new types of cotton, and it was concluded that "full understanding can only come as the result of complete investigations of the interactions of the various properties of the material, the machinery and the settings employed, and the physical conditions, notably the temperature and humidity, under which the tests and spinnings are made. Some progress in this direction has already been made, but the problem of the relation between fibre-properties and spinning value yet remains a problem of the first importance, and it is a problem on which much research is still needed."

Although a good deal of research work has been published in the intervening years, the last remarks apply with no less force now than when they were written. Some progress has undoubtedly been made, but very much more remains to be done before the problem is finally solved. A point has now been reached when it may be useful to pause for a moment and survey the ground that has been gained, and to cast a glance at the difficult country that lies ahead, for it must be recognized that the investigations that have been completed have served indeed to emphasize the difficulties that surround the problem, and to direct attention to possible new methods of attack. In reviewing the recent contributions to the subject, it may help if the essential problem is stated in symbolical terms. As pointed out in a previous paper[2] (1926), "our ideal would be the

formulation of an equation, so that by inserting therein the appropriate ascertained values for the various (fibre) properties, we should at once be able to determine, by solving the equation, the counts for which the cotton would be suitable under standardized conditions. Thus, if we represent the length of staple by x, the ribbon-width by y, the area of cross-section by z, and so on, we should have the general equation for the valuation of C, the finest count for which the cotton is suitable:

$$C=F\ (x,\ y,\ z,\ \ldots\ldots\ldots)$$

Unfortunately, little or nothing is known about this function."

At the same time it was pointed out that a beginning had been made, though it was only in the direction of simplifying the right-hand side of the equation—not of solving it—by ascertaining what relationships, if any, existed between the various fibre-properties, x, y, z, etc.

On the other hand, it must be recognized that the cotton-grader's method of valuing the quality of cotton is in essence an attempt to solve this equation in terms of the fibre-properties that he determines by hand and eye—viz., length, regularity, drag, strength, etc.

Before proceeding further it should be made plain that no prediction-formula of the type referred to above could be expected to do more than apply within certain limits. As it could only be derived by means of actual spinning tests, so its application could only legitimately be expected to cover the same range as these actual spinning tests. For instance, any such derived formula would presumably assign an actual, if low, " highest standard count " for a cotton having a staple length of only $\frac{1}{8}$ inch, whereas in point of fact such a cotton would not be spinnable in any count, whatever the values of its other fibre-properties. Evidently, any of these other fibre-properties might, under certain conditions, also assume the aspect of a limiting factor, and of the existence of such limiting factors the prediction-formula would take no cognizance.

Some attempts at the prediction of spinning quality yield very simple forms of the generalized equation. Thus, Winterbottom[3] (1921) has given various formulæ for selecting the length of staple required for a given count, and these formulæ reduced to the general form:

$$C=K\times(\text{staple length})^3,$$

where K=23 for ring twist, 29 for mule twist, and 37 for mule weft.

But numerous examples could be adduced to show that cottons of the same staple length do not by any means always have the same spinning value.

A similar criticism may be made of an attempt by H. H. Willis[4] (1927) to specify spinning value in terms of fibre-length and fibre-strength together, although in reviewing his results Willis only claims that "the data indicate that fibre-length accounts for 61 per cent. of the yarn-strength and that fibre-strength accounts for 11 per cent. of the yarn-strength." Willis's results were obtained for forty-three lots of cotton representing varieties grown in Texas and in North and South Carolina, and ranging in staple length from $\frac{13}{16}$ to $1\frac{1}{4}$ inches.

The relation between yarn-strength and fibre-strength has always excited much interest. Bowman, the outstanding early pioneer of scientific enquiry concerning the cotton fibre, pointed out the great discrepancy between the lea-strength of yarn and the aggregate strength of the fibres comprising the yarn; he was followed by Monie in similar strain, though both actually underestimated the discrepancy. Some explanation of the discrepancy has been attempted by the present writer[5] (1928), though the results for fourteen Indian cottons published at the time did not reveal any correlation between lea-strength of yarn and intrinsic fibre-strength, as indicated by the ratio of the fibre-strength to the fibre-weight per inch. Somewhat similar results were obtained by Burd for ten Sea Island cottons and by Barritt[6] (1929) for fourteen Sakel cottons. Yet the obvious inference that yarn-strength was not dependent on fibre-strength could not really be regarded as acceptable, for it has long been known that when a yarn is tendered by acid attack or by exposure to light the fall in yarn-strength is accompanied by a fall in fibre-strength. Various reasons were given some years ago by the writer[5, 15] to explain this result, and experimental support for these reasons was forthcoming at a later date when Gulati and Turner[7] (1930) showed that in favourable circumstances short lengths of yarn could exhibit a strength equal to, or even exceeding, that calculated from the fibre-strength.

An attack on a wider front was conducted by Morton[8] (1930), who investigated the spinning qualities of a wide range of fifteen samples of cotton in conjunction with three fibre-properties—viz., fibre-length, fibre-strength, and fibre-weight. He calculated a number of correlation coefficients for yarn-properties and fibre-properties, but he did not attempt to use these to obtain any prediction-formula to derive the one from the other, his general conclusion being that the relationships that he had found were "not sufficiently rigid to warrant their use in particular cases."

Finally, from this point of view reference may be made to the still more comprehensive investigation by Turner and Venkataraman[9, 10]

(1931, 1933). This investigation had for its deliberate aim the derivation of a prediction-formula of finest counts of warp yarn spinnable from a cotton in terms of six of its fibre-properties—viz., fibre-length (l), fibre-weight per inch (w), ribbon-width (d), fibre-strength (s), fibre-convolutions (c), and fibre-rigidity (r); these measurements were made on more than twenty Indian cottons in four or more seasons, making ninety-five samples in all; all types of Indian cottons were included in this series suitable for counts ranging from 7's to 42's. As a first approximation, and in order to simplify the problem, it was assumed that the relationship was of the simplest possible type—that is, linear. The prediction-formula thus obtained was:

$$C = 71{\cdot}6\ l - 70{\cdot}8\ w - 20{\cdot}8\ d + 17{\cdot}9\ s + 0{\cdot}037\ c + 4{\cdot}4\ r - 14{\cdot}1.$$

Actually a whole series of prediction-formulæ was developed, some based on one fibre-property only, and others based on various combinations of fibre-properties. The accuracy of these prediction-formulæ was tested by comparing the actual spinning values with those calculated by means of the various prediction-formulæ. When the prediction-formula based on fibre-length alone was used, it was found that the difference between the actual and predicted spinning values did not exceed 20 per cent. in 69 per cent. of the cases; the prediction-formula based on the fibre-weight per inch was less accurate, as for this only 53 per cent. of the cases were included between the same 20 per cent. limits of accuracy; but the prediction-formula based on fibre-length and fibre-weight together included 76 per cent. of the cases between the same limits, a percentage which was only raised to 80 per cent. when ribbon-width, fibre-strength, fibre-convolutions, and fibre-rigidity were also included within the ambit of the prediction-formula. For all practical purposes, therefore, little advantage in accuracy of prediction was gained by measuring any of these fibre-properties besides those of fibre-length and fibre-weight per inch.

In the course of the accumulation of the data for this investigation it had been observed that in a number of cases cottons having practically the same values for the fibre-properties had in fact given yarns differing widely in spinning value; and as the only property which had not been measured among those which most obviously might be expected to play some part in spinning value was the clinging-power of cotton, a range of forty-five Indian cottons was selected for measurement of this property in addition to those previously mentioned, and a prediction-formula based on all these fibre-

properties of the forty-five samples was similarly developed. In some respects the material is unsatisfactory for the application of the method of correlation used in obtaining the prediction-formula, as the samples were of a deliberately selected kind. However, on testing the accuracy of this formula on the data from which it had been derived, it was found that in all except two out of the forty-five cases the actual and predicted values of finest warp counts spinnable did not differ by more than 20 per cent. Actually the agreement was in many cases very close indeed, and on the whole was probably decidedly better than could be estimated by hand-stapling methods. Still, the outstanding exceptions were quite inexplicable; they both related to a Dharwar-American cotton, Gadag I, which had practically the same fibre-properties in the two seasons 1924-25 and 1926-27, so that the prediction-formula assigned the same counts to each—viz., 28's; yet the spinning test showed the 1924-25 sample to be suitable for 20's counts, and the 1926-27 sample to be suitable for 38's counts—a difference far transcending any that could be ascribed to experimental error.

Before we leave the subject of the direct correlation method some reference may be made to the correlation coefficients between the highest standard warp counts and the various fibre-properties. The ninety-five Indian samples previously referred to show a wide range, being suitable for counts ranging from 7's to 42's, which may be regarded as the coarse to medium range, and mathematically equivalent in extent to the range from medium to fine—say 40's to 240's counts; the ninety-five samples give total correlation coefficients of 0·87 between highest standard warp counts and fibre-length, and $-0{\cdot}80$ between highest standard warp counts and fibre-weight per inch; the corresponding values for the equivalent of 460 samples of Indian cottons were 0·87, as before, for the total correlation of spinning value with fibre-length and $-0{\cdot}75$ for the correlation with fibre-weight. From these results it follows that if one of these fibre-properties were to be used as a sole guide to spinning quality, it would be preferable, in the case of Indian cottons, to use the mean fibre-length rather than the mean fibre-weight per inch.

It is possible that the *total* correlation for fibre-length is higher than that of fibre-weight per inch because it includes the effect of some other factor or factors having a stronger correlation with fibre-length than with fibre-weight per inch. Whether this is so or not can be tested by calculating the appropriate partial correlation coefficient in which the effect of any measured character is eliminated as desired; when this was done for the ninety-five Indian cottons, it was found

that the partial correlation coefficient between spinning value and fibre-length was only 0·70 when the effects of correlation with the other fibre properties (weight, width, strength, convolutions, and rigidity) were removed, but between spinning value and fibre-weight per inch the partial correlation coefficient was still less, being only −0·36 when the effects of the other five properties were removed. The only apparently outstanding fibre-property not included in this list was the clinging-power, and when this was measured for the forty-five Indian cottons previously mentioned it still did not provide the desired solution, for when the effect on the correlation of this as well as the other five fibre-properties was removed, the total correlation coefficient of 0·70 for spinning value and fibre-length was reduced to the partial correlation coefficient of 0·52, while the total correlation coefficient of −0·78 for spinning value and fibre-weight per inch was reduced to −0·23. Both the total and partial correlations in this series of forty-five samples have been affected by the deliberate selection of the samples, and it is, of course, still possible that some other unmeasured fibre-property is responsible for the apparently transcending importance of fibre-length; but all the evidence so far available thus goes to show that not only is the fibre-length the best single fibre-property on which to base an estimate of the spinning value of Indian cottons, but that it is also *intrinsically* of greater importance than fibre-weight or any other property.

This conclusion does not necessarily apply, however, to other large groups of cottons. In a large collection of 371 samples, comprising 206 Empire and 165 chiefly Egyptian cottons, the total correlations between highest standard counts and fibre-properties were 0·77 in the case of effective length and −0·68 in the case of fibre-weight per inch. Thus for the whole series of samples the fibre-length again appears to be the best index of spinning value; but when the Empire and Egyptian cottons were considered separately, the total correlations were:

$$\text{For the Empire cottons} \quad \begin{cases} 0{\cdot}38 \text{ for effective length,} \\ -0{\cdot}46 \text{ for fibre-weight per inch.} \end{cases}$$

$$\text{For the Egyptian cottons} \quad \begin{cases} 0{\cdot}82 \text{ for effective length,} \\ -0{\cdot}84 \text{ for fibre-weight per inch.} \end{cases}$$

From these values of the total correlation coefficients it is evident that either fibre-length or fibre-weight per inch by itself affords a poor guide to the spinning value of the Empire cottons, though fibre-weight per inch is slightly better than fibre-length, whereas the two fibre-properties each afford an equally good indication in the

case of the Egyptian samples. These differences illustrate a point familiar to statisticians—that the correlations depend upon the universe of samples chosen for investigation. At the same time it must be remembered that the *complete* theory of spinning value in terms of fibre-properties must embrace the whole universe of cotton samples of whatever type or conditions of growth.

Of course, it might be argued that there are still many possibilities remaining to be explored before the direct correlation method is finally discarded. For instance, the objection might be raised that the discrepancies between calculated and actual values arise from errors of sampling or experiment. But special precautions were taken in testing the " standard Indian cottons " to avoid such errors, and it can be safely affirmed that they have, in fact, been avoided, for great care was taken in the mechanical process of sampling, and very large numbers of tests were made of each property by independent observers. Again, exception might be taken to the particular single value—the arithmetic mean—taken as representative for any particular sample; in the case of fibre-length, for example, is the mean value really representative, or would not the modal value or the effective length be better ? All the fibre-properties are highly variable within any sample, so should not some account be taken of this variability ? Yet again, the prediction-formula has been assumed to be of a linear type; would it not prove more accurate if a polynomial relation were assumed to exist in the case of some of the fibre-properties ? These are among the many possibilities that might still be explored, but to do so would require a similar elaborate testing of far more samples than those used, and an exceedingly laborious arithmetical computation afterwards. And even if it were carried out, a comparison of the properties of the two Gadag I samples of 1924-25 and 1926-27 shows that it might still fail to reconcile the results obtained for this cotton in these two seasons.

It seems, then, that an attack on the problem by this extensive method has reached the limit of its utility; it may be added that a similar conclusion has to be drawn from the results of a very large number of certain other fibre and spinning tests that have been carried out at the Shirley Institute.

If no solution of the problem of predicting spinning value is forthcoming from the direct correlation method, some other method must needs be found to replace it. As a link between these investigations depending directly on correlation and those which do not, reference may be made to the work of T. Bühler[11] (1927). Bühler, indeed, has in effect assumed a knowledge of the relative importance

of the fibre-properties, which it is the object of the correlation method to determine, in developing a system by which points are allocated to various fibre-properties—viz., staple and regularity, maturity and content of foreign matter, strength and colour. It is applied to a series of cottons in order to determine, first, their relative ranks for all the measured properties, and, finally, their spinning market values with reference to a standard. Not unnaturally, the system suffers at present from a number of drawbacks, the chief being the arbitrary nature of the allocation of the points.

An attempt to solve the problem by a combination of extensive and intensive methods is detailed by Balls[12] (1928) in his "Studies of Quality in Cotton." Balls's discussion centres round thirteen samples of American cotton of very similar staple length, in dealing with which he states that "the general discussion is not based upon them alone, but on the observation of yarns and cottons of every type, from 10's Indian to 300's super Sea Island." He does not employ the method of correlation in dealing with his results, because "it would be quite inappropriate to such a short series of thirteen to employ rigid treatment by correlation methods alone." These thirteen samples were subjected to a most elaborate series of tests; the fibres were tested for length, weight, ribbon-width, wall-thickness, strength, convolutions, slipperiness, wax- and ash-content; the yarns (singles and twofolds) were tested for lea strength, impact strength, and extension, and also for single thread strength at various lengths of specimen. It is impossible in this brief review to discuss the various novel conceptions introduced by Balls. Although his "general conclusion is that the lea test is a rational one, in spite of its composite nature," he is dissatisfied with this and all other conventional measures of yarn-strength, and considers that due regard should be paid to the fact that all yarns do not show the same percentage changes in strength when tested on various lengths of specimen. From the study of the thirteen samples Balls reaches three major conclusions: "First, that the strength of the yarn is in every respect a logical consequence of three chief properties of the cotton hairs. Secondly, that these samples can be arranged in various orders of merit according to the purpose for which they are to be used. Lastly, that while the lea test is a useful guide to their most likely and usual order, it is always composite, somewhat indefinite, and may sometimes be quite fallacious." The three fibre-properties referred to in the first of these conclusions are fineness by weight, slipperiness, and strength, according to Balls's general conclusion that "once the fundamental difficulty of instability in singles has been overcome, the

relation between cotton and yarn becomes quite reasonable and not very intricate. Fineness by weight acts twice over, as also does slipperiness, while the strength of the cellulose wall itself is the chief remaining factor; though one character of cotton which we have been able in the past to measure easily, namely, length, is definitely less important than any of these three." It will be noted that this last conclusion is contrary to the results of the previously mentioned tests on the Indian cottons, although, as Balls is dealing with prime causes, any comparison must, of course, be restricted to the partial correlation coefficients obtained for the Indian cottons.

Balls's conclusion concerning the relative unimportance of fibre-length may not be unconnected with the fact that the thirteen American samples so exhaustively tested by him differed only slightly in fibre-length, for the mean lengths of the whole thirteen samples fell within the range 1·05 to 1·15 inch, and the mean lengths of ten of them fell within the range 1·05 to 1·09 inch.

Finally, reference may be made to quite a different method of attacking the problem put forward by Foster and Gregory[13] (1930). The strength of an *element* of yarn depends upon its weight and twist, so from a knowledge of this relation and also of the variation in the weights of the elements along a yarn, it should be possible to predict the strengths of the weak places and their distribution, and hence the strength of any length of the yarn. Their method is therefore directed towards finding how the variation in weight (*i.e.*, the irregularity) depends upon the properties of the cotton, and how the strength of the yarn varies with the weight and twist at the place of break. They point out that it is not satisfactory, however, to correlate the irregularity of the yarn directly with the fibre-properties, "because the irregularity depends upon the way in which the total draft is distributed among the various machines, and, of course, also upon the counts of the yarn." Their method, therefore, is "to make a thorough study of the drafting at one machine with the object of finding a general relation between irregularity, draft, and other conditions. The coefficients in this relation may be correlated with the hair characters, and this would reveal at once what characters lead to good drafting and hence to uniform yarns." We may express Foster and Gregory's method symbolically as follows, retaining the highest standard counts as our criterion of spinning value:

$C = F(I, S)$, where I = irregularity due to drafting, etc.;
S = effective strength of the fibres;

and $I = F(x, y, z \ldots\ldots\ldots)$,
where $x, y, z \ldots\ldots$ represent values of the fibre-properties, as in our previous equation.

To solve the first equation in terms of fibre-properties S also has to be expressed in such terms; on this point the authors express their belief that "it should not be impossible to devise a laboratory bundle test which will give a closely related result" (to the effective strength).

This method, though *prima facie* it appears to be less direct, may ultimately prove more successful in solving the difficulties presented by the anomalous results of the direct correlation method, in fulfilment of their claim that although "this method appears to be even more empirical than the correlation method . . . actually it promises to yield far more fundamental knowledge of the spinning processes, and so lead to a spinning equation which will be more thoroughly understood." No results of an investigation by this method have been published.

We see, then, that if we discard the direct correlation method we are still left with alternative methods such as that suggested by Foster and Gregory. But while systematic investigation along their lines is bound to prove laborious and its completion possibly distant, other investigations may proceed along collateral lines. Perhaps the more immediately fruitful of such methods now at our disposal is an exhaustive analysis of just those cases which have proved refractory to the correlation method. If two samples, such as those of Gadag I previously mentioned, appear to be alike in most of their fibre-properties, yet widely different in spinning value, it is clear that some as yet unconsidered fibre-property must be responsible for the difference. What is wanted, therefore, is a number of pairs of samples covering a wide range of cottons, such that the two cottons of each pair resemble one another very closely in the generally measured fibre-properties and yet differ considerably in spinning value; or such that the spinning values of the pair are just the opposite of what would be expected from the fibre-properties. From the results for the ninety-five standard Indian cottons it appears that the cottons should first be selected by reference to their mean fibre-lengths and fibre-weights; the values for the fibre-properties and the yarn-properties of the different pairs must then be verified by re-testing, as it is, of course, essential that the primary facts should be correct. This having been done, the cotton fibres and the yarns may both be further examined. The yarns can be examined first, in order to discover whether the differences in these are due to differences in yarn-irregularity or to differences in the effective strengths of the cottons.

The importance of yarn-irregularity and its relation to yarn-strength have not perhaps always been realized, yet it is probably

true to say that it is the increasing irregularity as finer counts are spun from a cotton that actually limits the fineness to which it can be spun; and varieties differ from one another largely in this, that the limiting count is reached at a much lower count for one than for another. This is illustrated in Fig. 1, showing a series of cottons all spun into 16's; and in Fig. 2, showing another series of cottons spun into 50's. Three cottons—Uppers, Memphis, and Tanguis—are included in both series, and it is interesting also to compare their irregularities in the two counts. As Balls[12] (1928) has shown, the principal cause of the yarn-irregularity is what he has termed the "drafting wave," produced when cotton sliver or roving is drafted between pairs of rollers rotating at different speeds.

An important point to note in connection with yarn-irregularity is that as yarn-strength is necessarily determined on some fixed length, the question naturally arises, What is the standard fixed length to be? This gives rise to another difficulty, because two yarns with different yarn-irregularities may have the same strength for one length of test-specimen, but different strengths for another length. A curious example of this effect of irregularity on strength was described by the writer some years ago[14] (1918): a certain cotton fabric was slightly stronger in the weft direction than in the warp, when subjected to an ordinary tensile test; but when tested after being wounded with a series of central transverse cuts, the warp invariably gave a much higher value for tearing strength than the weft. The number of threads in each direction was practically the same (152 warp and 148 weft), and the yarns were of the same count (80's) and twist; the fabric had practically the same extension in both warp and weft directions. Yet when the yarns were tested on 18-inch lengths they appeared to have equal strengths; it seemed, then, that the only possible explanation of the differences in tensile properties was that the warp yarns were more irregular than the weft; in ordinary fabrics this is unusual, but the matter was nevertheless investigated experimentally by testing the yarns also on 3-inch lengths, when it was found that the warp yarns were much stronger than the weft yarns—the warp yarns were, in fact, decidedly more irregular in strength, and thus the differences in breaking and tearing strengths of the fabric in the two directions were satisfactorily accounted for.

The relation between length of test-specimen and yarn-strength dependent on the yarn-irregularity has been the subject of a number of investigations [Turner[15] (1920), Peirce[16] (1926), Balls[12] (1928)]; and Peirce[16] (1926) has worked out a theory leading to a formula by which, from a knowledge of the strength-irregularity and of the

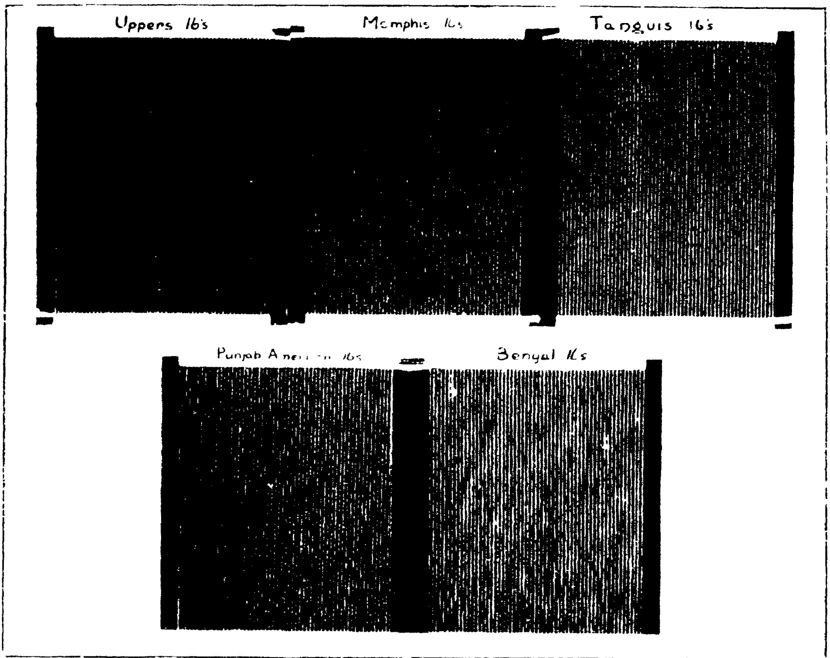

FIG. 1.—WRAPPINGS OF 16'S COUNTS, SHOWING THE DEPENDENCE OF YARN-IRREGULARITY UPON VARIETY OF COTTON.

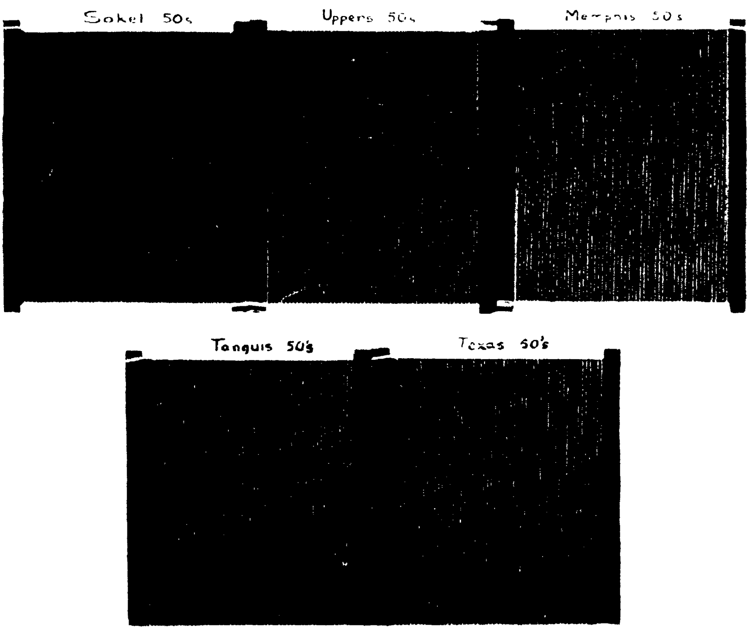

FIG. 2.—WRAPPINGS OF 50'S COUNTS, SHOWING THE DEPENDENCE OF YARN-IRREGULARITY UPON VARIETY OF COTTON.

strength at one particular length, the yarn-strength can be calculated for any other length of specimen.

There is, indeed, some reason to think that the chief difference between different varieties of cotton is not in their effective strengths, but in their irregularities. A measure of support for this view is given by some results of Gulati and Turner[7] (1930), who found that when test-specimens only 3 inches long were carefully selected to be as free as possible from yarn-irregularity, a number of Indian cottons had nearly the same strength, at a given count and a given twist, for counts from 20's to 40's and for twists of twenty turns per inch and over; in particular the two cottons which were the extremes of the series, Umri Bani and Punjab-American 289F, had equal strengths at these twists, though at lower twists the Punjab-American 289F gave decidedly higher strengths than the Umri Bani, owing to the coarser fibres of the latter cotton slipping more readily than those of the Punjab-American 289F. Yet spinning tests had shown that the highest standard warp-count of the Umri Bani was only 24's, as compared with 40's of the Punjab-American 289F.

A method of determining the " effective strength " of a cotton has been described in the afore-mentioned paper by Foster and Gregory[13] (1930).

When a pair of anomalous yarns has been examined for yarn-irregularity and the effective strength of the cottons, the cottons themselves may be further examined. First, the results of the test for fibre-length and fibre-weight per inch may be analyzed in order to ascertain whether there are any differences in irregularity of these fibre-properties to account for the differences in spinning value. As previously indicated, all cotton varieties display wide variation of fibre-properties; for instance, the longest fibres of any variety are usually at least four times as long as the shortest, with a complete range of other lengths in between; similarly, the heaviest fibres are usually about four times as heavy as the lightest, per unit length. But the actual percentages of the various lengths or of the various weights of fibres may differ from one variety to another, even though both have the same mean values. It may be added that the general question of the irregularity of fibre-properties has formed the subject of a paper by Underwood[17] (1930).

Fibre-irregularity is linked with the degree of maturity of the cotton. In considering the results for the hair-weight per centimetre of fifty-five samples of cotton, Morton[18] (1926) plotted the hair-weight per centimetre against the square of the mercerized hair-width, and drew through the points a line AB of best fit, and con-

cluded: "Thus all points falling above the line AB, which most fairly indicates the general relation between the two characters, would be expected to represent well-developed cottons, while those falling below should signify immaturity." This classification was justified by reference to the appearance of sections cut from several cottons lying at different distances from the line AB.

The importance of the degree of maturity of a cotton sample has, in fact, received increasing recognition in recent years. Roehrich[19, 20] (1928, 1933) has included this among one of the most important measures of fibre-quality, expressing it as a "coefficient of maturation," which is in effect the mean area of cellulose in the cross-section expressed as a percentage ratio of the area of the circle having the mean ribbon-width as diameter. The effective area of cross-section (S) is obtained by dividing the hair-weight (expressed in suitable units) by 1·5, the density of cellulose. The mercerized diameter is measured, and is divided by 0·8—a correction factor obtained by Calvert and Summers[21] (1925)—to give the "diameter" (D′) of the raw cotton; from D′ is calculated S′, the area of the circle having diameter D′. The coefficient of maturation is then given by the relation $\frac{S}{S'} \times 100$. Roehrich gives two tables of results: in the first table are twelve cottons in four commercial classes—Indian, American, Uppers, and Sakel or Sea Island; in this table the values of the coefficient of maturation range from 46·5 for "Prima Capou" to 57·1 for Sea Island; in the second table, for indigenous or exotic French colonial types, the values range from 39·2 for an A.O.F. cotton to 60·9 for a North African cotton. He accordingly classifies cottons by this criterion as follows: 35 to 40, very bad; 41 to 45, mediocre; 46 to 50, fairly good; 51 to 55, good; 56 and over, very good.

Another method that has been extensively used for some years at the Shirley Institute aims at classifying directly the individual fibres in a sample as being normal, thin-walled, or dead, according to their appearance under the microscope after swelling in caustic soda solution. [The method has been described in a paper by Miss Clegg[22] (1932).] Under these conditions normal hairs lose their convolutions, and dead hairs become convoluted; thin-walled hairs are recognizable as such, though they have affinities, of course, with the two classes on either side. A large number of results of the application of this test for "immaturity" have been given in Miss Clegg's paper; a well-matured cotton may have 70 per cent. normal, 20 per cent. thin-walled, and 10 per cent. dead fibres, though higher values for the

normal and lower values for the dead fibres are often obtained. Immature cottons have lower values for the normal and higher values for the dead hairs. Results given in the paper for seventy cotton samples range from 97 per cent. normal, with no dead hairs, for Bengals, to 31 per cent. normal, with 39 per cent. dead hairs, for Punjab-American.

In these special cases dealing with anomalous pairs of samples it may be desirable also to measure, possibly by new methods, some of the fibre-properties to which reference has already been made—namely, fibre-strength and clinging-power. And, finally, measurements might be made of the form assumed by individual fibres when unconstrained. It appears possible that, in the drafting processes, fibres which are by nature badly contorted may exercise a disturbing influence on other fibres, besides behaving themselves like much shorter fibres. Such disturbing effects are more likely to occur with coarse cottons, as they would require larger forces to overcome their natural constraints. A few measurements made by the writer on such coarse cottons have shown that the actual length of the fibre may be as much as 75 per cent. greater than the shortest distance between the two ends of the unconstrained fibre.

Enough has now been said to indicate the nature of the means by which the problem of predicting the spinning value of a cotton may be further investigated. And while it must be confessed that the frontal attack by the method of correlation has not been rewarded by a complete solution, yet it seems permissible still to cherish the comforting reflection that the resources of research methods are by no means exhausted.

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POTASH STARVATION AND THE COTTON PLANT

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THE cotton crop which was harvested from the Permanent Manurial Plots at the Imperial College of Tropical Agriculture in 1932-33 showed in some cases obvious symptoms of potash starvation, and opportunity was taken to subject material from different plots to more detailed examination, with distinctly interesting results.

These Permanent Manurial Plots are laid out on the ordinary five-plot system, one plot receiving a complete manure, while the others are deprived, one at a time, of one of the three ingredients—nitrogen, phosphoric acid and potash; the fifth plot is deprived of them all—*i.e.*, it receives no manure. There are three series of such plots: one as above; one similar, except that it received at the start of the experiment a dressing of ground limestone sufficient to satisfy the lime requirements of the soil; while the third receives a dressing of compost or synthetic farmyard manure in addition to the mineral manures.

The manures, except the limestone, are applied to every crop, and the land is being cropped as heavily as possible—if necessary, with irrigation—in order that the differential treatment may exert its effect as quickly as possible.

Cropping on these lines started in October, 1929, but it was some time before the levelling of the plots was satisfactory, and the first crop it was considered worth recording was in October, 1931; since then the cropping has been as follows:

1. *Oryza sativa* (Hill rice) ... ... May, 1931–September, 1931.
2. *Phaseolus vulgaris* (Kidney bean) January, 1932–March, 1932.
3. *Crotalaria juncea* (Sunnhemp) ... March, 1932–June, 1932.
4. *Zea mays* (Maize) ... ... July, 1932–November, 1932.
5. *Gossypium hirsutum* (Acala cotton) November, 1932–March-April, 1933.
6. *Setaria italica* (Foxtail millet) ... May, 1933–August, 1933.

The yields of the cotton crop are given on next page :

TABLE I.—PERMANENT MANURIAL EXPERIMENT.

(Plots $\frac{1}{20}$ acre—all figures per acre.)

CROP NO. 5: GOSSYPIUM HIRSUTUM (ACALA COTTON).

Series.	*Plot No.*	*Manurial Treatment.*	*Yield of Kappas (Lbs.).*	*Percentage of Unmanured.*
I. ...	4	Nil.	320	*100*
	5	N + P.	500	156
	6	N + K.	1,020	318
	7	P + K.	940	294
	8	N + P + K.	1,220	381
II. ...	12	Ca.	460	*100*
	13	Ca + N + P.	260	56
	14	Ca + N + K.	1,020	221
	15	Ca + K + P.	980	213
	16	Ca + N + K + P.	980	213
III. ...	3	Com.	1,940	*100*
	11	Com. + Ca.	1,740	89
	9	Com. + Ca + N + P.	1,460	75
	1	Com. + Ca + N + K.	1,600	82
	10	Com. + Ca + P + K.	2,020	104
	2	Com. + Ca + N + P + K.	2,040	126

N =1 cwt. of Sulphate of Ammonia to each crop.
P =2 cwt. of Superphosphate of Lime to each crop.
K =$\frac{1}{2}$ cwt. of Sulphate of Potash to each crop.
Ca =10 tons at beginning of experiment (January, 1931).
Com. =10 tons compost or synthetic farmyard manure to each crop.

It will be noted at once that the crop was a good one, for yields of this order are by no means the rule in Trinidad. The dry sunny weather, with occasional showers, of March and April favoured ripening, and not only was the crop good in quantity, but exceptionally clean and of good quality.

It is clear, further, that organic matter is of the greatest value on this land, which is light and porous in texture, and is rapidly depleted of nutrients under the heavy rainfall conditions of Trinidad. The average yields from the three series for the last three crops are as follows:

TABLE II.

Series.		*Crop Number.*		
		No. 4.	*No. 5.*	*No. 6.*
I. ...	...	*100*	*100*	*100*
II. ...	...	95	92	100
III. ...	...	105	225	120

It may be surmised that the greater effect of the organic manure on the cotton crop is due to the dry weather; the other two crops were both grown during the rainy season, when the soil may be waterlogged for a portion of the time.

As regards the minerals, it is fairly clear from the figures that the plots not receiving potash are suffering from a shortage of that ingredient. This is marked in the first two series, though masked to some extent by the heavy dressings of organic manure in Series III.

It seemed, therefore, an excellent opportunity to estimate the effect of potash starvation on the development of the cotton fibre. The plots were adjacent, and conditions, except for the supply of potash, similar and fairly favourable. Accordingly, five samples were collected from the total pickings from plots Nos. 4, 5, 6, 7 and 8 and sent to the Empire Cotton Growing Corporation, who arranged for their examination at the Shirley Institute.

The results of the tests are given in Table III.

A letter accompanying the report states that "each row represents an entirely independent test, including sampling from the seed cotton packages," and examination of the figures shows that there are considerable differences between such samples, sufficiently great in some cases to preclude safe conclusions being drawn.

In spite of such differences, it may be stated that the shortage of potash shows up fairly definitely in a very low proportion of normally thickened hairs. None of the treatments are good in this respect, with figures of 45, 44 and 41 per cent., but plots 4 and 5 have only 36 and 42 per cent., and larger proportions of dead fibres, though in this respect the plot lacking phosphorus (No. 6) also shows up badly. There is, moreover, a very definite increase in the proportion of short fibres, 16 and 12 per cent. as compared with 5, 6 and 7 per cent. from the plots receiving potash, and this is associated with rather higher figures for dispersion percentage, showing that the lint is more irregular. Further, there is evidence that the seeds are lighter in weight from these plots and that, in spite of this, the percentage of lint to seed cotton is lower.

It may be presumed that it is a question of general nourishment rather than of any specific effect of the absence of potash. The poorest lint is produced by the plot which receives a sufficiency of nitrogen and phosphoric acid, but no potash, which is noticeably inferior to the plot which receives no manure at all, even though it produced 50 per cent. more lint.

TABLE III.

Plot.	Treatment.		Mean. (In 32nd of an Inch.)	Mode.	E.L.	D%.	S%.	Hairweight per Cm. Mean.	Sorted Long to Short.	Imm.	Defective Seeds per 100.	Seed Weight.	Lint Weight.	Lint (Per Cent.)
8	Complete minerals	(1)	38	40	42	14	3	140	127, 136, 146, 150, 142	45–14	1	0·123	0·081	39·7
		(2)	34	38	40	20	7	164	162, 162, 171, 174, 150	38–24	1	0·122	0·077	38·7
		(3)	40	39	42	14	4	176	159, 159, 161, 190, 209	29–17	—	—	—	—
	Mean	...	*37*	*39*	*41*	*16*	*5*	*160*	*149, 152, 159, 171, 167*	*44–18*	*1*	*0·123*	*0·079*	*39·2*
7	Without nitrogen	(1)	38	40	42	12	4	184	161, 169, 187, 200, 205	46–18	0	0·126	0·085	40·3
		(2)	34	39	41	20	12	176	162, 168, 172, 174, 176	36–22	0	0·124	0·081	39·5
		(3)	37	39	42	17	4	181	162, 174, 182, 196, 190	53–20	—	—	—	—
	Mean	...	*36*	*39*	*42*	*16*	*7*	*180*	*162, 170, 180, 190, 190*	*45–20*	*0*	*0·125*	*0·083*	*39·9*
6	Without phosphorus	(1)	38	40	42	14	3	167	136, 165, 185, 185, 161	44–25	0	0·129	0·081	38·6
		(2)	34	38	40	20	7	172	167, 172, 176, 180, 164	43–22	3	0·125	0·082	39·6
		(3)	36	38	41	15	8	162	142, 155, 166, 177, 169	37–20	—	—	—	—
	Mean	...	*36*	*39*	*41*	*16*	*6*	*167*	*148, 164, 176, 181, 165*	*41–22*	*2*	*0·127*	*0·082*	*39·1*
5	Without potash	(1)	33	36	40	20	14	142	126, 135, 150, 154, 146	32–30	11	0·101	0·064	38·8
		(2)	30	34	38	24	19	161	154, 174, 168, 156, 153	38–24	3	0·104	0·065	38·5
		(3)	31	35	39	23	15	147	157, 147, 147, 148, 140	39–27	—	—	—	—
	Mean	...	*31*	*35*	*39*	*22*	*16*	*150*	*146, 152, 155, 153, 146*	*36–27*	*7*	*0·103*	*0·065*	*38·7*
4	No minerals	(1)	36	40	41	12	7	181	148, 159, 193, 202, 202	41–23	2	0·116	0·072	38·3
		(2)	31	36	39	23	14	176	165, 168, 190, 186, 170	43–16	2	0·113	0·071	38·6
		(3)	33	40	40	18	16	165	149, 166, 182, 167, 159	43–27	—	—	—	—
	Mean	...	*33*	*39*	*40*	*18*	*12*	*174*	*154, 164, 188, 185, 177*	*42–22*	*2*	*0·115*	*0·072*	*38·5*

E.L.=Effective length. D%=Per cent. Dispersion. S%=Per cent. Short Fibre.

Imm.=Immaturity figures — Per cent. normal in the first column, per cent. "dead" in the second, "thin-walled" comprising the remainder, to make up 100 per cent.

Summary.

The yield of cotton from plots at the Imperial College of Tropical Agriculture, Trinidad, which showed definite symptoms of potash deficiency, was very much lower than that from plots which had received potash, while the lint was shorter, more irregular and contained a larger proportion of poorly thickened hairs.

Acknowledgment.

I am glad to take this opportunity of expressing my thanks to the Director and Staff of the British Cotton Industry Research Association for their kindness in carrying out the tests recorded in Table III.

Received October, 1933.

RILEY TAKES A HAND

BY

W. GILHESPY

MOOSA KHAN asked the money lender to call again. It was a request he had been making ever since he inherited the grazing lands on the dry Seenabad plain. For the average Mahomedan cultivator and grazier is born to debt and dies in debt. He inherits his father's debts, just as the Indian moneylender inherits the power to keep him in debt.

The moneylender was not perturbed at the debtor's inability to pay; he would have been surprised and disappointed had the money been forthcoming. He was getting only a little over thirty per cent. on his money, much less than he usually charged, but Moosa Khan was a safe borrower. Every moneylender regards the law which prevents his seizing a debtor's land as but another expression of British tyranny, but there were always other methods of applying the screw.

For the zemindar was as proud as he was poor. He was the virtual ruler of his village and of all who lived within three miles of it. His subjects were men of his own race, loyal to the British raj chiefly because Moosa Khan was loyal. They would share in his disgrace if he were dragged to court because he would not or could not pay his debts.

But the time came when he had to sell nearly all he had or be forever dishonoured. For Soonder Singh, a greater usurer than any which the zemindar had ever known, bribed his cousin to give him early information as to what direction the fourth branch of the new canal would take. The cousin was confidential clerk to the Chief Engineer of the Navaraki Canal District, and Soonder Singh was the first outsider to know that before long enough canal water would flow across the dry Seenabad plain to grow corn for generations yet unborn.

Soonder Singh cared little for those who would till that plain long after he had been carried to the burning ghat, and less for the grain that would feed them. He cared only for that which would bring him money and still more money, so he pinned his faith to cotton.

He was a moneylender and owned ginning mills; the two trades

go well together in India. A man who has cultivators in his power can make sure that they sell their cotton to him alone, and on his terms. Moosa Khan's land had never been cultivated with the exception of one corner; the rest lay too high, but the irrigation water would reach it.

So he coveted Moosa Khan's land and knew exactly how to get it. He could spend money freely when he was sure of a rich return, and he bought out the local usurer's interest in the zemindar; then he began to turn the screw.

When the zemindar begged for time to pay the interest it was granted with a smile, and no demand was made for the liquidation of the debt till Moosa Khan came for a further loan. It was refused, again with a smile, and for the first time in his life the zemindar was unable to help one of his dependants.

He sold immature cattle and fulfilled the obligations of his position; Soonder Singh gave the screw another turn. When he insisted on part payment of the interest Moosa Khan sold a valuable colt and curtailed his expenditure; even the hospitality which the Oriental loves to display was not on such a lavish scale.

More screw turning; the zemindar's dependants began to suffer. When he was unable to help those who had always relied on him for succour he was humbled to the dust. Still the screw was turned, till at last he was faced with the alternative of selling the larger part of his land or facing utter ruin.

The terms were generous; it was no part of the usurer's plan to crush him, he meant to use him when the canals began to function. Without Moosa Khan's assistance cotton growing would have been an unprofitable venture, because not one of the local men or women would have worked for him till the zemindar gave the word; and to bring labour from a distance would have been much too costly.

So Moosa Khan made the best of a bad bargain and pocketed such of the purchase money as was due to him after the half of the debt was liquidated and a fresh agreement, which reduced the rate of interest, was made. He was still in the usurer's power and could not help himself, but was inclined to think that Soonder Singh would not be a very hard taskmaster when he gave him a fairly generous contract for clearing the jungle in preparation for cotton growing.

"Leave this long strip of tall jungle, *wadero sahib*." Soonder Singh was always careful to give him his full title and to treat him with courtesy. "It will serve as a wind break and save the cotton pods. Moreover I shall take out a licence to grow poppies, and the delicate petals must not be blown away."

"But there is little wind here and only a very mighty wind can

damage cotton," Moosa Khan explained, but was not much concerned when the other insisted.

So he kept the villagers busy at the clearing and later saw cotton growing on the land which his forefathers had owned in the days when an over-extortionate moneylender had his throat cut instead of having the assistance of the courts.

It was good cotton, grown on land that had never been cultivated for lack of water, and so had never been exhausted. Moosa Khan superintended the cultivation because the crop was grown on the *bhatai* system, by which the cultivator provides bullocks and labour while the owner pays for seed, water rates and land tax, each party to the agreement taking an agreed percentage of the profits.

The crop paid owner and cultivators well; Moosa Khan had to admit that his villagers were better off than when they had worked solely for him. But the knowledge galled him because their prosperity would have come through him had the usurer not used his knowledge to filch his land from him. Had he only learnt of the coming of the canal in time he would have been a rich man, instead of having half his glory dragged from him by one of the tribe which every Mahomedan cultivator loathes.

His hatred of the moneylender grew, even when Soonder Singh employed him and his villagers to clear more land. He would have loved to refuse, but none would suffer more than his people if their income were stopped.

Their prosperity, however, increased as more and more cotton was grown. Then one day Soonder Singh imported two coolies for the poppy growing. Opium can only be produced under licence, and a man of the Abkhari* Department came to inspect the land. He looked like a smaller, less prosperous edition of Soonder Singh, and Moosa Khan knew him for a caste fellow of the moneylender.

The Hindu coolies who had been brought for the purpose cultivated the poppies, scarified the seed pods when they swelled, collected the juice which exuded, and made a fresh wound each morning till no more juice flowed, and the withered pods were gathered for the anodyne properties still remaining.

The white-petalled opium poppy can only be grown under strict supervision, and the Abkhari man paid frequent visits. He measured the acre under poppies with meticulous care much more often than seemed necessary, as Moosa Khan remembered later.

The poppies were grown on a fresh patch of ground the following year and the land which was cleared, but which was still surrounded by

* Excise Department.

a strip of jungle, was devoted to vegetables, more Hindu coolies being brought to cultivate them. To the village cultivators it seemed a strange proceeding, for the produce had to be carted fourteen miles to the nearest town, and it was only when Moosa Khan heard Riley's opinion that he saw a ray of light. Soonder Singh was in *his* power now!

Riley was something of a sportsman and more of a naturalist. He shot black buck on the Seenabad plain and an occasional cheetul stag in the jungle to the south of it, but cared more for the study of wild life than for its destruction. He kept the villagers supplied with game during his brief visits, and it was when he shot a black partridge that he entered the vegetable field.

He was surprised when the Hindu coolies, working at the far end, ran towards him and begged him to go back.

"Fear ye that the sahib will steal your worthless crops?" Moosa Khan demanded, angry that his guest should be insulted. "Soonder Singh shall hear of this."

"It was Soonder Singh who bade us keep all intruders away," one of them said, but Riley went straight towards where the bird had fallen and retrieved it after a short search.

"How much land does that moneylender put down to poppies?" he asked later. He was a railway traffic officer of another district, and was curious to know why any man should grow a few poppies here and there among his carrots and other vegetables.

"An acre? Only one acre? Is that all he has a licence for? He has four or five among his garden stuff. Do you know what that means? He is the man who filched your land from you, isn't he? We must talk this matter over. But I have much to learn first, much. How much opium should be gathered from one acre of poppies?"

Moosa Khan knew nothing of opium growing, but promised to watch carefully and send word when the opium was sent away and the traffic officer would be able to trace it to its destination. He did trace it, but that did not help in the least; no more had been sent than might have been expected from one acre; later he learnt that even that had been weighed and packed and consigned under Government supervision.

Soonder Singh had been sending cotton to his own mills; the railway traffic records showed that. But why had he sent three bales of cotton to a city a hundred and fifty miles away, each on a different date? Had he sent the opium in those bales with a few days between each consignment so that he would not have all his eggs in the same basket?

There was always the possibility that it might have been delivered to a local illicit dealer along with a supply of vegetables. The police would know if there were men of that class in the city where those vegetables went, but Riley wanted nothing to do with the police on this job. The police would bowl the lawbreakers out if they could and hand the case over to the Abkhari Department for prosecution.

This was just what he did not want. Moosa Khan had caught him prowling round with his gun when he had been new to India and bewildered by the people's strange ways. To his apologies for trespassing the zemindar had turned a deaf ear and marched the sportsman to such a meal as he had never tasted before. Then a score of labourers had downed tools to drive quail from the dry herbage till his gun barrels were uncomfortably warm.

He knew more about India later, but that introduction to Oriental hospitality, courtesy and friendship was something he did not forget, and he owed some service to the zemindar. Moosa Khan's range of ideas was limited, and Riley had to do the necessary thinking in this business.

It was most likely that the opium had been delivered to some mysterious consignee in those three bales of cotton. He was sure of it when the man could not be traced; the railway receipt had been handed in by a bullock cart driver who had gone off with each separate bale—the clerks could not be sure that it was the same man in each case.

He had to wait another year before he could do anything towards trapping Soonder Singh, but he did not mind the delay so much when he learnt that the astute moneylender had built a fence round his vegetable field after enlarging it. The excuse that he had to keep the deer from his crops was too flimsy; even the Forest Department, with abundance of free timber and cheap labour, had found it more economical to use barbed wire.

Moosa Khan had managed to enter the enclosure when the poppies were in bloom, and reported that the area under cultivation was at least seven acres. That was in addition to the acre being grown under Government supervision, and Riley was satisfied.

The crop was a good one that year, and Moosa Khan sent his report to a man who could not read a word of Hindustani. The zemindar could not have read it either, but the strange scrawls had a meaning that each understood. When a sheet of notepaper over which a spider might have crawled after wading through an inkpot was received, the traffic man knew by the torn corner of the sheet that the opium had been dispatched under Government supervision.

An oval sketch on the next told that a single bale of cotton was on the railway; it was time to move.

It was part of Riley's work to make a surprise visit to the less important railway stations and inspect the books. He was in time to learn where the cotton had gone, and reached its destination by mail long before the bale was unloaded from the goods train.

He had a few men who were regularly employed on enquiries, and one of them followed the cartman who received delivery of the bale, and quietly noted the address, appearance and the name of the man who received it. Riley guessed that no more bales would be sent till Soonder Singh knew that the first had been safely delivered, and he was in time to see the second booked; then he waited till dark before going to the zemindar's house.

It takes a lot of practice before a white man can disguise himself so as to defy detection when he tries to pass as a native of India, but it was scarcely daylight when he knocked at Soonder Singh's door next morning, and the uniform of a native police constable helped, especially the headdress.

" I have come for the rest of the opium," he said as he snapped the handcuffs on the usurer's wrists. " One bale has been delivered to thy brother rogue in Naffirganj and the other is now on the rail. Don't lie—never mind the licence—I know all about that. Will you show me where the rest is hidden or shall we search? The inspector and his plain clothes men will be here to take charge, and if we miss the morning train through delay thou wilt be sorry. *Wadero sahib*, watch this scoundrel while I find that opium."

Moosa Khan stood over the manacled wretch in silence for a moment, then leaned his broad shoulder against the lintel as though he watched the sunrise.

" They have searched the cow shed," he said carelessly, " now they are gone to the big shed. Is it well to give them much trouble, *babuji*? Surely it will make them angry."

" Bid them go, *wadero sahib*," the usurer pleaded through parched lips. " I will give them money, much money, to release me. Much money will I give."

" I was *wadero* of the village till my land was stolen from me by trickery; now I am helpless. I shall grieve to see one so wealthy taken away in the train with fetters on his wrists. Of what use is thy wealth to thee now, *babuji*?"

" Take it, *wadero*. Take all I have and bribe those men to go."

" I neither give bribes nor take them, *babuji*. The land thou filched —*that* I can take, for by trickery was my heritage taken from me."

" It is thine once more, with all I have built on it. Take it."

" Read this and sign, then will I call witnesses. It was written by a lawyer and is binding. Call also thine own witnesses."

But it was long before the usurer's witnesses could be found; the men who had been brought to cultivate the poppies had thought it best to go while the going was good.

But the carefully prepared deed of sale was signed at last; Soonder Singh gave his receipt for the purchase price, though he knew he would never get a penny.

Then Riley slipped away to get the grease paint off his face and neck and hide a police constable's uniform.

DIFFERENTIATION OF HAIRS ON THE SEED COAT OF COTTON—II.

[We have been asked to publish the following letter, but no further correspondence in connection with this discussion can be inserted.—ED.]

RESEARCH INSTITUTE,
LAWLEY ROAD,
COIMBATORE,
MADRAS.

SIR,

We much regret to note that Mr. Barritt, while discussing in his article " The Differentiation of the Epidermal Layer in Cotton Seed—II " (July, 1933, issue of the Review) our note on the " Differentiation of Hairs on the Seed Coat of Cotton," published in an earlier issue (January, 1933), has made, without producing further evidence to support his former assertions, some very misleading statements, as will be evident from the following instances:

(1) In the first place, he questions the accuracy of our dating the material and keeping it distinct. The basis for this charge is that the micro-photograph (Fig. 5B of our article) of the section of the seed coat of twenty-days-old seed does not show the long cells of the palisade layer, which should be quite prominent after the seventh day. We can only say that such a layer does exist in our section also, but it was not brought out in the photographic field as our figure was intended to show the production of a broad-based hair from sub-epidermal cells. A more complete photograph of the identical section (Fig. 1) is reproduced now in which the elongated palisade cells are evident just below the " inner epidermis of the outer seed coat " (Balls), which has been mistaken for " incipient palisade layer " by Mr. Barritt.

(2) Further, he misquotes us when he writes in that paragraph that " . . . some of these stages could be prolonged over a period of seven to twenty days, as suggested by Ayyar and Ayyangar. . . ." What we stated was " . . . we did not detect actual mitosis in the epidermal cells beyond the second day after flower opening, but the *nucleus* was prominent in them till they were twenty days old. . . ." " . . . These *primordial lint cells* have not been noticed later than in sections of seven-days-old ovules."

(3) In discussing the hair bases, he entirely disagrees with our observation that the hairs with flattened bases are from the sub-epidermal region and that they grow out through the stomata, his objections being that the cells adjacent to these hairs are far

bigger in size than those of the ordinary guard cells, and they are seen pigmented in our sections when they ought to be free. We have only to point out that the above two conditions are actually observed when the seed coat is young. As the seed coat ripens, the wall between the guard cell and the neighbouring epidermal cells disappears, and the entire cell gets pigmented (Figs. 2, 3 and 4).

Again, if the explanation offered by Mr. Barritt for the constricted bases of the hairs be correct, one would expect that the same laws of hydrostatic pressure developing along the line of least resistance would be applicable to the hairs produced on naked seeds as well, so that some proportion of the hairs should be broad-based. But actual observation shows practically complete absence of such hairs on the seed coat sections of naked seeds (Figs. 5 and 6).

(4) Mr. Barritt endeavours to prove that the number of fibres per seed given by us are consistently higher than those derived by him from the unit fibre weight and lint weight, and comes to the conclusion that the discrepancies which he imagines to have discovered must be due to our not properly adjusting the zero of the micro-balance. Obviously he has failed to understand the differences in the two methods.

We may point out that the numbers of fibres furnished by us were obtained by the method described by Iyengar and Turner in their bulletin (Technological Bulletin, Series B, No. 7, Indian Central Cotton Committee). These will always be higher than those obtained by dividing lint weight by the unit fibre weight (which is the product of the mean fibre weight per unit length and the average length per fibre), so long as the value of correlation between the weight of fibre per unit length and fibre length is not exactly equivalent to -1 (minus one). For in the former method the average length involved is according to the distribution of the number of fibres in each group length, while in the latter it is according to the distribution by weight, as obtained in the Balls Sorter. As the exact relationship between the distribution of length according to the number of fibres and according to the weight has been clearly explained by Iyengar and Turner in their paper, we refrain from going into further details. But suffice it to say that the average length obtained from the number of fibres is in all cases smaller than that obtained from their weights, with the result that the number of fibres according to the first method is always greater than that from the second. Similar differences will be found in the results furnished by Iyengar and Turner in their bulletin if the numbers obtained by the two methods are likewise compared.

(5) We fail to understand the logic of Mr. Barritt when he says that a correlation coefficient of $+\cdot66$ is not significant for nine sets of readings, and hence our conclusion is unjustifiable, while he attempts to show later from a correlation of $+\cdot67$ for eight sets of readings, though hardly of much significance, that

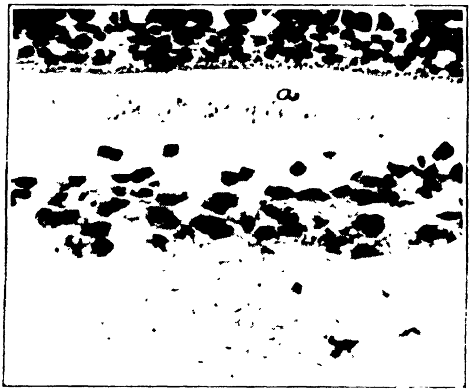

Fig. 1. Seed Coat of Cambodia Co. 2 Twenty Days Old (Fig. 5b of our Previous Article reproduced under Low Power of the Microscope). (*a*, Palisade layer).

Fig. 2.- Seed Coat of *G. indicum* Fifteen Days Old. (*a*, Guard cells; *b*, Broad-based hair).

Fig. 3. -Seed Coat of Acala Twelve Days Old. (*a*, Guard cells; *b*, Broad-based hair).

Fig. 4.—Seed Coat of Mollisoni—Twelve Days Old.
(*a*, Guard cells and epidermal cell fused; *b*, Broad-based hair).

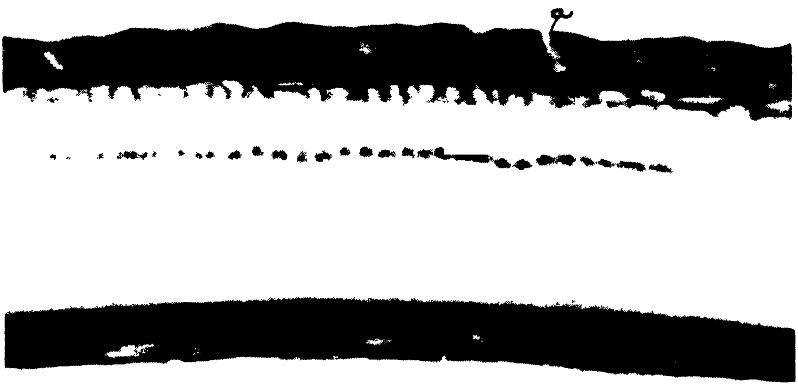

Fig. 5.—Matured Seed Coat of Sea Island (Naked Variety).
(*a*, Hair base.)

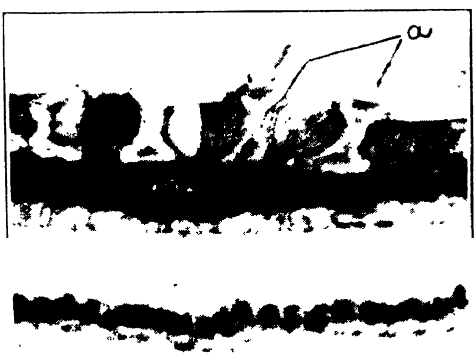

Fig. 6.—Matured Seed Coat of Cambodia Co. 2 (Fuzzy Seed).
(*a*, Broad-based thick hairs; note the absence of these in the naked seed.)

the lint weight per seed is more influenced by unit fibre weight than by the number of fibres. A similar inconsistency is also noted when he refers to the differences between the unit fibre weights given in the technological reports obtained from bulk samples of five years and those given in our note that were derived from a single day's picking, as " discrepancies," while he is prepared to admit a difference of 20 to 40 per cent. in unit fibre weights recorded by Turner in Punjab Cottons as " variations." It is a matter of common knowledge that lint weight, lint length and fibre weight per unit length are greatly influenced by seasonal conditions.

Lastly, we have to point out that it is quite possible for any researcher to go wrong in his interpretation of the results obtained, and he should therefore gladly welcome a more correct interpretation based on further observations. But surely it is not in consonance with scientific spirit to presume others to be careless when they happen to differ.

We are glad to note that the results of Farr's later researches on the differentiation of lint cells (contributions from Boyce Thompson Institute, vol. v., No. 2, pp. 167-172, 1933) are in accordance with our observations on the same, recorded in our previous note.

We remain, Sir,

Yours truly,

V. R. AYYAR.

G. S. AYYANGAR.

COTTON STATISTICS

BY

JOHN A. TODD, M.A., B.L.

With the beginning of a new volume and a new decade in the history of the Journal it has been thought desirable to make a change in the arrangement of the statistics which are published in every issue. In the past the plan has been to deal with one subject in each quarterly issue as follows: Consumption and Stocks in the January issue, World's Crops and American and Egyptian Crops in April, Indian and Smaller Crops in July (with the Empire Crops table supplied by the Corporation), and Prices in October. The disadvantage of that system was that each subject was only dealt with once a year; but in some cases, like the World's Crops, the current figures are changing all the time. In others, like Consumption, the Federation figures appear only half-yearly, but Garside, of the New York Cotton Exchange, is now publishing monthly statistics of World's Consumption of all kinds, which supplement very usefully the figures of consumption in the U.S. published monthly by the Census Bureau. Again, while season's average prices can only be given once a year, it would be very useful to have the movement of actual prices, both spot and futures, more frequently.

Under the new arrangement it is proposed to make the tables shorter by cutting out the early years, but to give as many as possible in each issue and bring them down to date. The figures for previous years can always be found by referring to past volumes.

Table I. World's Crops.—This table gives the latest figures for the 1932-33 crops and the four previous years, together with such estimates as are available for the season 1933-34. The feature of the past season was the heavy reduction of the American crop, which was only set off to a small extent by the increase of Outside Growths. The details of Outside Growths show increases of about half a million bales for both India and China, while East Africa also showed a very satisfactory increase, but Mexico, Egypt, and the Sudan were all heavily down.

For the coming season it is already evident that the position will be very different. The American crop, in spite of all that has been done by the Government to secure reduction of acreage, is likely to

be actually larger than last year's crop; but the total of Outside Growths shows a very marked increase on last year, and if present prospects are realised will certainly set up a new record. The increase is very widespread. The first official estimate of the Indian crop is not yet available, but there seems good reason to believe that it will continue last year's improvement, and it will be noted that even our guess of 5 million bales would leave it a long way below the record of 6,215,000 bales in 1925-26. China also looks like repeating last year's increase, and if it does so will be very nearly a new record, though not quite, for in 1918 it was 2,903,000 bales. The out-turn of the Russian crop this year is still doubtful. For the first time there has been a slight reduction in the acreage, but this will not necessarily involve any reduction in the crop, and the estimates so far available indicate a further small increase. Egyptian again, owing to the relaxation of the acreage restrictions and a very bountiful yield in Upper Egypt, is showing a very marked increase on last year's small figures, and looks like setting up a new record.

Table II. gives further details of the American crop from 1927 to 1932. In this table we have used the revised figures published by the Government in May, 1933, when all the acreage figures back to 1866 were gone over and mostly reduced. As the figures of the crop yield were not altered, the result is that the average yield of the American crop for many years back has been raised to the extent of about 5 per cent. It follows that all the figures given in this part of the table are different from those given in previous issues, but it has not been thought worth while to carry the revision back through the whole period.

The second half of this table—Progress of the Season 1933-34—is a new feature in these statistics, which is perhaps justified by the extraordinary juggling with the acreage figures this year. The acreage planted in July was reduced by fully 10 million acres in August by the Government's special abandonment scheme. In the August Bureau the acreage harvested is based on the ten years' average abandonment, but in September this is replaced by an actual estimate of abandonment, which it will be noted was much less than the ten years' average, so that the figure of acreage harvested was increased, although the special abandonment was actually greater. But the remarkable feature of the American crop reports this year is the extraordinarily high yield; so far it has just failed to reach that of 1931, which was by a long way the highest on record since 1914—*i.e.*, before the boll weevil covered the Belt.

Table III. gives the history of the Egyptian Crop for the last five years, with the estimates for 1933-34 as far as available. It will be noted that we have for the first time given alternative crop figures. In former years we have always used for the total crop the Adjusted Arrivals of the Alexandria General Produce Association, but in recent years the Government have been publishing their own figures of the total crop, based on the final ginning figures adjusted for changes in stocks at the beginning and end of the season, and it will be seen that in 1930 and 1931 there is a considerable difference between the two sets of figures. In this table we have also given the seasons' average spot prices both for Sakel and Uppers, whereas in former years only Sakel was given.

Table IV. World's Consumption.—This follows the same form as in previous volumes, but gives only six years. The new figures for 1932-33 show a very satisfactory increase in the world's consumption of American last year, which was fairly well distributed. Indian, on the other hand, showed a considerable reduction and Egyptian was also slightly down, but Sundries showed a very large increase in Asia, this being mostly due to increased consumption of the native crop in China. On the whole, the result is an increase of about 2 million bales in the world's consumption of all kinds of cotton.

Table V. U.S. Consumption by Varieties.—The main interest of the monthly figures given in this table is that it brings out the extraordinary recovery of consumption in the U.S. in the last three months of the season, which was to no small extent responsible for the increase in the world's consumption. The June consumption was actually a new record for any month in the history of these statistics, which go back to 1912. These high figures have not been maintained in the early months of the current season, but that was not to be expected, for the heavy consumption in the last quarter of the season was to a large extent in anticipation of higher prices resulting from the new Code for the textile industry, which it is said has increased the cost of production of cotton goods in the U.S. by as much as 25 per cent.

Table VI.—We propose to give the American and Egyptian Carry-overs half-yearly in alternate issues. The chief interest of the Egyptian table given in this issue is the further heavy reduction of the total at the end of July, 1933. This was, of course, the result of the small crop, for consumption, as already noted, was not heavy; but it may be noted here that the position will certainly be reversed in the coming season; for, with the large crop already in prospect, the season's supply (Crop+Carry-over) will be very nearly record-

breaking, and in spite of lower relative prices there is no prospect of such an increase in the consumption as would take up the whole of the coming crop and prevent an addition to the Carry-over at the end of the season.

Tables VII. and VIII. Prices.—The season's average prices were given in the October issue, but in the new series we propose to give periodically two tables, one of the highest and lowest prices of near month futures of American in Liverpool and New York and of Egyptian both Sakel and Uppers in Liverpool, which will give a much better idea of the trend of cotton prices in general throughout the season. New York is included because in view of recent monetary developments it is necessary to distinguish between the inflated prices in New York and those of Liverpool, which for the moment have become the best indication of the world price of cotton. The second table gives the relative spot prices of the chief varieties of cotton expressed as percentages of American. This brings out more clearly the movement of the relative prices of these different varieties, which is the most important matter both for growers and for spinners.

TABLE I.—WORLD'S COTTON CROPS.

(Bales of 500 Lbs.—000's).

	1928–29.	1929–30.	1930–31.	1931–32.	1932–33.	1933–34. *Estimates.*
U.S.A. Lint	14,478	14,825	13,932	17,096	13,002	13,177
Linters	1,282	1,241	986	1,067	900	950
Total	15,760	16,066	14,918	18,163	13,902	14,127
Mexico	272	240	174	204	95	223
Brazil	528	564	470	556	348	650
Peru	220	266	231	218	200	220
Argentine	129	138	150	167	160	150
Other South American	65	66	49	43	40	40
India*	5,782	5,243	5,224	4,025	4,516	5,000
China	2,441	2,069	2,300	1,703	2,260	2,672
Japan and Korea ...	147	137	152	101	127	147
East Indies, etc. ...	16	18	17	13	15	15
Russia	1,174	1,279	1,589	1,851	1,864	1,964
Persia	90	73	72	110	100	100
Iraq, Ceylon, etc. ...	4	4	3	1	†	†
Asia Minor and Europe	138	143	120	133	66	83
Egypt	1,602	1,697	1,589	1,313	1,010	1,785
Sudan	129	127	96	188	110	140
East Africa (British)	196	135	174	177	255	259
South Africa (British)	8	14	8	3	2	2
West Africa (British)...	26	35	15	5	19	20
Non-British Africa ...	109	121	128	93	100	100
West Indies (British)...	4	4	4	2	2	2
West Indies (Others) ...	23	25	21	21	29	25
Australia, etc.	5	10	10	4	16	16
World's Total ...	28,868	28,474	27,514	29,094	25,236	27,740
Outside Growths ...	13,108	12,408	12,596	10,931	11,334	13,613
Per cent. on Total ...	45·4	43·6	45·8	37·6	44·9	49·1

* Government Estimate, 400 lb. bales. † Less than 500 bales.

TABLE II.—AMERICAN CROP (EXCLUDING LINTERS).

	1927–28.	1928–29.	1929–30.	1930–31.	1931–32.	1932–33.
Acreage planted (000's)	39,479	43,735	44,458	43,339	39,109	36,542
Acreage harvested ...	38,349	42,432	43,242	42,454	38,705	35,939
Crop (running bales)...	12,783	14,297	14,548	13,756	16,629	12,710
Yield per acre (lbs.) ...	161·7	163·3	164·1	157·0	211·5	173·3
Season's average spot price (Liverpool—pence per lb.) ...	11·17	10·52	9·09	5·71	4·82	5·62

Progress of the Season 1933–34.

	July.	*August.*	*Sept.*	*Oct.*	*Nov.*	*Dec.*
Acreage planted ...	40,798	30,494	30,402	30,402	30,402	30,533
Acreage harvested ...	—	29,704	30,036	30,036	30,036	30,144
Crop (500 lb. bales) ...	—	12,314	12,414	12,885	13,100	13,177
Yield per acre (lbs.)...	—	194·8	197·8	205·3	208·7	209·4

TABLE III.—EGYPTIAN CROP.

	1928–29.	1929–30.	1930–31.	1931–32.	1932–33.	1933–34.
						Estimates.
Area (feddans, 000's) ...	1,738	1,841	2,082	1,683	1,094	1,804
Crop (kantars, 000's):						
Alexandria adjusted arrivals	8,012	8,485	7,947	6,563	5,050	8,925
Government figures ...	8,068	8,531	8,276	6,357	5,000	8,604
Average yield (kantars per feddan)	4·64	4·63	3·97	3·78	4·57	4·77
Season's Average Spot Prices (Liverpool—Pence per Lb.).						
Sakel	18·14	14·52	9·06	6·80	7·79	
Percentage on American	72·4	59·7	33·6	41·1	38·6	
Uppers	12·12	10·47	6·86	5·68	7·01	
Percentage on American	15·2	15·2	20·1	17·8	24·7	

TABLE IV.—WORLD'S CONSUMPTION OF COTTON.

(FROM THE STATISTICS OF THE INTERNATIONAL FEDERATION.)

(*Running Bales, 000's—Excluding Linters.*)

Variety.	*Season.*	*U.K.*	*Continent.*	*U.S.A.*	*Asia.*	*Others.*	*Totals*
American ...	1927–28	1,949	5,143	6,535	1,513	267	15,407
	1928–29	1,910	4,614	6,778	1,431	333	15,066
	1929–30	1,474	4,055	5,803	1,427	256	13,015
	1930–31	991	3,242	5,084	1,345	239	10,901
	1931–32	1,342	3,313	4,714	2,636	251	12,316
	1932–33	1,400	3,836	6,003	2,655	266	14,170
Indian ...	1927–28	121	962	27	3,389	24	4,523
	1928–29	183	1,150	35	3,766	44	5,178
	1929–30	188	1,375	61	4,403	60	6,087
	1930–31	252	1,215	43	4,318	35	5,863
	1931–32	183	727	21	3,834	23	4,788
	1932–33	126	600	16	3,455	23	4,220
Egyptian ...	1927–28	358	394	145	43	17	957
	1928–29	365	401	155	43	25	989
	1929–30	301	415	137	58	26	937
	1930–31	242	420	70	96	25	853
	1931–32	301	480	53	120	26	980
	1932–33	301	442	58	104	29	934
Sundries ...	1927–28	476	1,557	64	1,646	911	4,654
	1928–29	342	1,947	55	1,480	815	4,639
	1929–30	502	2,044	51	1,825	740	5,162
	1930–31	479	1,984	42	1,648	711	4,864
	1931–32	560	1,730	26	1,133	786	4,235
	1932–33	421	1,797	32	1,922	856	5,028
All kinds ...	1927–28	2,904	8,056	6,771	6,591	1,219	25,541
	1928–29	2,800	8,112	7,023	6,720	1,217	25,872
	1929–30	2,465	7,889	6,052	7,713	1,082	25,201
	1930–31	1,964	6,861	5,239	7,407	1,010	22,481
	1931–32	2,386	6,280	4,844	7,723	1,086	22,319
	1932–33	2,248	6,675	6,109	8,136	1,184	24,352

TABLE V.—U.S. CONSUMPTION OF COTTON BY VARIETIES.

(Running Bales 000's: "Foreign" in Equivalent 500-lb. Bales.)

Monthly.	*Total.*	*Daily Rate.*	*Upland.*	*American Egyptian.*	*Egyptian.*	*Other Foreign.*	*Linters not Included.*
1932–33.							
August ...	404·5	16·2	393·3	1·6	6·4	3·2	48·4
September ...	492·7	20·7	480·0	1·8	6·3	4·6	65·5
October ...	502·2	21·6	488·2	1·6	7·9	4·6	58·0
November ...	503·7	21·4	490·0	2·1	7·9	3·8	52·3
December ...	440·1	20·0	429·0	1·7	6·6	2·7	44·3
January ...	471·2	19·8	461·5	1·1	6·0	2·6	48·4
February ...	441·7	20·3	432·2	1·9	6·3	2·1	46·5
March ...	494·2	19·8	482·6	2·0	7·2	3·2	50·1
April ...	470·7	21·2	460·0	1·2	6·2	3·3	54·7
May ...	620·9	25·1	606·5	1·1	9·3	4·0	76·1
June ...	696·5	29·0	681·0	1·6	9·0	4·9	81·5
July ...	600·1	26·7	583·9	1·5	9·7	5·1	90·5
1933–34.							
August ...	588·6	25·6	571·3	1·2	11·3	4·8	83·3
September ...	499·5	24·1	485·7	0·9	9·2	3·8	76·5
October ...	503·9	23·2	489·0	1·1	9·6	4·2	66·8

TABLE VI.—WORLD'S CARRYOVER OF *EGYPTIAN* COTTON

(Kantars 000's).

End of	*Stock and Afloat.*		*U.S.A.*		*Alexandria.*	*Monthly Totals.*	*Federation. Other Mill Stocks.*	*Half-Yearly Totals.*
	U.K.	*Continent.*	*Mills.*	*Warehouses.*				
1929, July ...	510	150	449	197	1,677	2,983	1,260	4,243
1930, January	*585*	*270*	*353*	*202*	*3,403*	*4,813*	*1,335*	*6,148*
July ...	353	135	483	245	3,616	4,834	1,297	6,131
1931, January	*630*	*293*	*341*	*129*	*5,349*	*6,742*	*1,185*	*7,927*
July ...	600	165	212	108	4,456	5,541	1,418	6,959
1932, January	*1,013*	*248*	*145*	*63*	*5,521*	*6,990*	*1,447*	*8,437*
July ...	885	203	161	180	3,780	5,209	1,553	6,762
1933, January	*878*	*218*	*134*	*169*	*4,255*	*5,654*	*1,425*	*7,079*
July ...	742	202	130	143	2,375	3,592	1,635	5,227
August ...	705	158	122	130	1,723	2,838	—	—
September	675	180	107	110	1,805	2,877	—	—
October	803	202	121	88	2,561	3,775	—	—
November	1,102	277			3,095			

Figures in *italics* to distinguish between Mid-Season and end of Season.

TABLE VII.—HIGHEST AND LOWEST PRICES (NEAR MONTH FUTURES).
AMERICAN—LIVERPOOL AND NEW YORK.
EGYPTIAN—LIVERPOOL, SAKEL AND UPPERS.

	American.				*Egyptian.*			
	New York.		*Liverpool.*		*Sakel.*		*Uppers.*	
	High.	*Low.*	*High.*	*Low.*	*High.*	*Low.*	*High.*	*Low.*
1932–33.								
August ...	9·48	5·80	6·90	*4·40*	9·15	6·84	8·14	5·87
September	9·44	6·82	*7·00*	5·24	*9·52*	7·92	*8·35*	6·87
October ...	7·32	6·10	5·64	5·03	8·30	7·33	7·18	6·70
November	6·66	5·67	5·41	5·04	7·85	6·98	7·08	6·58
December	6·20	*5·53*	5·12	4·75	7·13	6·54	6·64	6·05
January	6·43	5·92	5·14	4·76	7·39	6·77	6·76	6·30
February	6·30	5·85	4·89	4·61	7·08	6·67	6·38	6·01
March ...	6·97	5·93	5·17	4·50	7·16	*6·45*	6·39	*5·80*
April ...	7·90	6·41	5·31	4·82	7·28	6·84	6·53	6·02
May ...	9·42	8·03	6·19	5·37	8·28	7·24	7·34	6·55
June ...	10·75	9·10	6·39	5·81	8·37	7·95	7·37	6·97
July ...	*12·00*	9·58	6·34	5·75	8·31	7·86	7·44	6·95
1933–34.								
August ...	10·66	*8·47*	*6·12*	5·22	*8·02*	7·00	*7·21*	6·33
September	*10·71*	8·94	5·58	5·15	7·34	6·84	6·46	6·01
October ...	10·08	8·83	5·47	5·15	7·21	6·79	6·26	5·91
November	10·30	9·41	5·29	*4·78*	7·08	*6·52*	5·99	*5·44*

Maximum and minimum figures in each season are given in italics.

TABLE VIII.—LIVERPOOL SPOT PRICES OF AMERICAN (PENCE PER LB.) WITH OTHER VARIETIES AS PERCENTAGES.
(LAST FRIDAY OF EACH MONTH.)

Month.	*American (Middling).*	*Indian No. 1 Fine Oomra.*	*West African (Middling.)*	*Brazil Pernam (Fair).*	*East African (Good Fair).*	*Tanguis (Good).*	*Uppers (F.G.F.).*	*Sakel (F.G.F.)*
1932–33.								
August ...	6·45	89·1	100·8	101·6	115·5	119·4	119·4	135·7
September	5·73	87·3	101·7	101·7	119·2	126·2	124·1	145·7
October ...	5·62	88·8	101·8	101·8	119·6	125·8	127·4	138·8
November	5·44	89·7	100·0	101·8	120·2	125·7	129·2	139·0
December	5·29	89·4	100·0	101·9	119·8	125·5	131·4	137·4
January	5·15	89·5	100·0	101·9	117·5	125·2	128·9	139·4
February	4·95	89·5	101·0	103·0	119·2	126·3	129·5	141·8
March ...	5·15	80·0	100·0	101·9	117·5	126·2	124·3	137·9
April ...	5·53	80·7	100·0	101·8	119·9	124·4	121·2	134·7
May ...	6·07	80·1	100·0	101·6	114·8	122·2	120·4	134·6
June ...	6·38	80·6	100·0	101·6	114·1	121·2	116·9	131·2
July ...	6·47	81·0	101·5	101·5	113·9	120·9	118·7	131·1
Season average.	*5·62*	*86·1*	*100·7*	*102·0*	*117·4*	*124·2*	*124·7*	*138·6*
1933–34.								
August ...	5·53	79·6	101·3	103·1	115·7	124·8	122·4	136·0
September	5·60	80·7	100·9	103·6	114·3	124·1	114·6	132·0
October ...	5·54	78·3	100·0	102·7	113·5	122·6	111·0	127·4
November	5·09	77·6	100·0	102·9	114·7	120·6	112·6	137·7

NOTES ON CURRENT LITERATURE

COTTON IN INDIA.

1. The following reports have recently been received:
INDORE: Institute of Plant Industry. Progress Report to June 30, 1933.
MYSORE: Rpt. of Dpt. of Agr., 1932.
PUSA: Scientific Rpts. of the Imperial Council of Agricultural Research, 1931-32.

2. INDIAN COTTON: PRODUCTION, 1931-32. By C. B. Mehta. (*Cotton Trade J.*, Intern. Edn., 1933. Abstr. from *Summ. of Curr. Lit.*, xiii., **18**, 1933, p. 456.) A review of marketing conditions during the season. Statistics are given of acreage, production, " carry-over," and stocks on hand.

3. INDIAN CENTRAL COTTON COMMITTEE. At the twenty-seventh meeting, held on August 29, the following, among other important matters, were discussed: The situation arising out of the Japanese boycott of Indian cotton; the establishment of cotton markets in Bombay and Madras; the report of the Cotton Forecast Improvement Sub-Committee; the working of the Cotton Ginning and Pressing Factories Act. The various research schemes financed by the Committee were reviewed, nine schemes being extended for a further period, and three new schemes sanctioned. The half-yearly report of the Technological Laboratory at Matunga, and the progress report and programme of work of the Institute of Plant Industry, Indore, were discussed.

4. INDIAN CENTRAL COTTON COMMITTEE. We have received from the Publicity Officer the following notices:

Development of Cotton Growing in Sind. Summarizes (1) the results obtained by the Cotton Physiological Research Scheme; (2) the programme of work in connection with the extension of improved varieties of cotton in the Barrage areas; (3) the tests carried out at the Technological Laboratory on Punjab-American improved types and on imported cottons.

Safety-first Measures against Importation of Cotton Pests. Indicates the measures that have been taken during the past few years to safeguard the Indian cotton crop from foreign pests, especially the boll weevil. The process of fumigation of cotton bales in fumigation barges stationed at Princes Dock, Bombay, is briefly described. The Liston Fumigating Machine is used for the purpose.

5. INDORE INSTITUE OF PLANT INDUSTRY. PROGRESS REPORT FOR THE YEAR ENDING JUNE 30, 1933. The most important work—the improvement of cotton varieties—continues to progress, and the creation of a superior strain of rain-fed cotton for the Malwa plateau is now almost achieved. A certain amount of evidence has been collected tending to contradict the usual belief that continued selfing leads to reduced vigour. The effects of X-radiation of cotton seed, buds, and pollen upon subsequent generations were further studied, and unexpectedly, no aberrant types were produced. Work has also been done on the physiology of cotton, soil erosion, cotton wilt, etc. The success of the " Indore Compost System " continues to arouse interest both in India and in other countries. The system has been adopted on the farms of the United Provinces Department of Agriculture and by three large land cultivation companies, and it is in regular operation in a number of States.

6. SPINNING TEST REPORTS ON INDIAN COTTONS. By N. Ahmad. (*Ind. Cent. Cott. Comm. Tech. Circs.*, Nos. 102-109, 1932-33.) The circulars contain the

report of the Standards Committee and spinning-test results for Dholleras, Kadi-Viramgam, Muttia, Kalagin, Tinnevelly, Karunganni, Westerns, Farm Westerns, Kumpta, Upland, Bijapur, Bagalkote, Punjab-American, Cambodia, A.R. Kampala, A.R. Busoga, and A.R. Jinja cottons for the 1932-33 season.

7. Spinning Quality of the Indian Cotton Crop. By N. Ahmad. (*Anglo-Gujarati Qtrly. Jour. of the Ind. Merc. Chamber*, July, 1933.) A paper written by Dr. Ahmad to refute a statement made that "generally speaking the quality of Indian cotton from the viewpoint of spinning capacity has been declining every year." The author considers that the increase in imports of foreign cotton is due to the desire to spin finer counts.

8. Indian Cotton: High Draft Spinning. By H. Meynell. (*Text. Merc.*, 89, No. 2323, 1933. Abstr. in *Summ. of Curr. Lit.*, xiii., **20**, 1933, p. 512.)

9. Testing of Indian Cottons for Quality at the Technological Laboratory. By N. Ahmad. (*Tech. Bull.*, Ser. A., No. 25. *Ind. Cent. Cott. Comm.*, 1933.) A readable account of the methods employed in making spinning, fibre, and yarn tests. The standards of twist and strength, and the spinning quality of a cotton, are also discussed.

10. Technological Reports on Standard Indian Cottons, 1933. By N. Ahmad. (*Tech. Bull.*, Ser. A., No. 24, 1933. *Ind. Cent. Cott. Comm.*) The reports contain the results of tests on Standard cottons of the ten seasons 1923-33. As in former years, the Agricultural Details, Grader's Reports, Fibre Particulars, Spinning Tests Reports, and Remarks, are given for each of the eighteen Standard Indian cottons. This year a U.P. cotton, K. 22, has been omitted, since it failed to find favour with the cultivators, and a new U.P. cotton, C. 402, has been included.

Of the eighteen cottons tested eleven showed improvement while seven gave poorer results. The varieties showing improvement were Gadag 1, Surat 1027 A.L.F., Mollisoni, Punjab-American 4 F and 289 F, C.A. 9, Akola Verum, Umri Bani, Nandyal 14, Hagari 25, and Karunganni C. 7.

11. Mysore. *Cotton Cultivation.* (*Rpt. of Agr. Dpt., Mysore*, 1932, recently received.) The work on cotton at the Babbur Farm progressed satisfactorily. Selection 69 strain was grown pure on the farm for the purpose of supplying pure seed to the Maradihalli Co-operative Society, which was responsible for multiplying the seed for general distribution. Studies on the inheritance of certain desirable characters in cotton were continued, and two very good strains have been isolated. Testing for wilt resistance was also carried out.

12. Sind. Certain Varietal Studies on the Cotton Plant. By P. C. Mahalanobis and S. S. Bose. (*Ind. J. of Agr. Sci.*, iii., **2**, 1933, p. 339.) Tables are given showing the percentage success of boll formation from flowers for five different strains of cotton sown in 1929-30 and 1930-31 respectively. The results indicated that the selected varieties were superior to the controls.

13. The "Sukhada" Implement. By B. N. Sarkar. (*Agr. and Live-stock in India*, iii., **5**, 1933, p. 432.) The implement consists of the ordinary country plough of South Bihar to which three different attachments can be fixed for different purposes. These attachments are: a three-five tined cultivator; a furrower; a broad share. There are no bolts or nuts in the set of implements, and the device is simple and can easily be made and repaired by natives. It is stated that the work done by the implement compares very favourably with that done by more costly machinery.

COTTON IN THE EMPIRE (EXCLUDING INDIA).

14. The following reports have recently been received:

ROTHAMSTED EXPERIMENTAL STATION: Rpt. for 1932.
BRITISH GUIANA: Admin. Rpt. of Dir. of Agr., 1932.
CEYLON: Admin. Rpt. of Dir. of Agr., 1932.
FIJI: Agr. Journal, 1933.
Ann. Bull. of Div. Rpts., 1932.
KENYA: Ann. Rpt. of Dpt. of Agr., 1932.
NIGERIA: Ann. Rpt. of Northern Provinces, 1932.
SOUTH AFRICA: Year Book, 1931-32.
SUDAN: Ann. Rpt. of Sec. for Econ. Development and Stats. of For. Trade, 1932-33.
TANGANYIKA: 5th Ann. Rpt. of East African Res. Sta., Amani, 1932-33.
WEST INDIES: *Barbados:* Agr. Journal, vol. ii., Nos. 1 and 2, 1933.
Montserrat: Rpt. of Agr. Dpt. for 1932.
St. Kitts-Nevis: Rpt. of Agr. Dpt., 1932.

15. LIST OF AGRICULTURAL RESEARCH WORKERS IN THE BRITISH EMPIRE, 1933. (H.M. Stat. Off., 1933, 2s. net.) Last year merely a volume of Addenda and Corrigenda to the List for 1931 was issued. This year a new volume complete in itself is published. The list gives the names and addresses of agricultural research workers as on June 30, 1933, with the branch of science in which each is specially interested. It is divided into four parts: Part A gives details of the Bureaux—organizations formed for the distribution of scientific information among research workers; Part B, the names and addresses of research workers arranged under countries; Part C classifies them according to the subjects in which they are interested; Part D is an index.

16. THE PROGRESS AND DEVELOPMENT OF COTTON-GROWING WITHIN THE BRITISH EMPIRE. By Sir William Himbury. (*Cotton*, M/c., 14/10/33, p. 21.) A useful report, including a table giving areas, population, suitability of soils, approximate estimate of 1932 crop, and quality, for the principal cotton-growing countries of the Empire, followed by a brief summary of the work carried out and the progress made during the year.

17. THE BRITISH COTTON INDUSTRY RESEARCH ASSOCIATION. THE WORK OF THE SHIRLEY INSTITUTE, DIDSBURY, MANCHESTER. By Dr. R. H. Pickard, F.R.S. (*Cotton*, M/c., 14/10/33, p. 15.) An interesting paper on the work of the Shirley Institute, especially that part of it which is concerned with the problem of increasing the efficiency of opening and cleaning machines. Research on an entirely new principle of cleaning cotton has already had one practical outcome in the form of a small testing machine, called the " Shirley Analyser for Raw Cotton or Waste " which has recently been put on the market. The machine analyses a sample of raw cotton or waste into fractions—good cotton and trash, the percentage of each in the sample being readily determined. The ultimate separation of the trash from the cotton is accomplished entirely by pneumatic means, and in two passages through the machine practically the whole of the good cotton in a sample can be separated from the accompanying impurities. The production rate of the machine is low—only 8 lb. per hour—but this rate is ample for the purpose for which it was designed, as a complete test takes only a few minutes. The many uses to which the machine can be put are enumerated.

18. ROTHAMSTED EXPERIMENTAL STATION. The Report for 1932 deals among other matters with the work of the year in connection with field experiments, physical and chemical properties of the soil, biological decomposition of organic matter, plant pathology, insect pests, etc.

During the year 102 papers were published in various scientific journals, and summaries of 71 of these are included. The library continues to expand, and now contains some 24,000 volumes.

Dr. Stoughton, who had been in charge of investigations on bacterial diseases of plants, left Rothamsted in 1932 to take up the Professorship of Horticulture at Reading University. Before leaving he completed his study of the important parasite *Bacterium malvacearum*, which causes blackarm disease in cotton. Contrary to the general belief about bacteria, it has apparently a sexual stage characterized by the fusion of two cells, and the formation of a fusion body or zygospore. Further, it exists in many different strains, and these may remain constant for a long time, then suddenly they may "dissociate" into new strains which either persist or reproduce the parent type. This dissociation cannot be controlled.

19. ASIA: CEYLON. *Cotton Cultivation*, 1931-32. (*Ann. Rpt. of Dpt. of Agr.*, 1932, received 1933.) The season was a particularly favourable one for cotton cultivation, but, owing to various causes, including poverty, poor prices, and unemployment, much less cotton was cultivated in the Hambantota district. There was evidence, however, of a little interest in other parts. The crop was as usual sold to the Ceylon Spinning and Weaving Mills at a price of Rs. 12 and Rs. 6 per cwt. for first and second grade seed cotton respectively, delivered in Colombo, which was an increase of Rs. 2 per cwt. on the previous year's rates. The use of suitable and cheap implements, such as the Meston plough, Guntaka harrow, and bamboo seed drill was demonstrated to cultivators to show that time and labour could be saved by the adoption of implemental tillage. The variety of cotton grown, namely Cambodia, gave an average yield of 4-5 cwt. an acre under peasant cultivation, and a record crop of 10 cwt. seed cotton per acre was obtained at the Tissa Rotation Station.

20. AFRICA. AFRICAN COTTON: PRODUCTION. By J. L. Stewart. (*Cotton Trade J.*, Intern., Edn., 1933, p. 31. Abstr. from *Summ. of Curr. Lit*, xiii., **18**, 1933, p. 455.) A review of recent history of cotton growing in the newer regions of Africa under British, French, Belgian, Italian, and Portuguese guidance, giving statistics of production.

21. GOLD COAST. *Cotton Cultivation*, 1933. (*Bull. Imp. Inst.*, xxxi., **3**, 1933, p. 418.) According to the report of the Acting Director of Agriculture for the half-year January-June, 1933, field trials with cotton at Kpeve Station in Southern Togoland were continued. Yields in the season 1932-33 were a record, and the imported Nigerian cotton (Improved Ishan) maintained its reputation as a superior yielding cotton to Togoland cotton (Sonko). The Ishan cotton not only gave the high yield of 1,026 lb. of seed cotton per acre when sown at the best planting date, but yielded considerably better than Sonko cotton in the later sowings. The Ishan cotton was also tested on twenty half-acre plots cultivated by farmers in villages throughout the cotton-growing area; the yields of these plots ranged up to 696 lb. of seed cotton per acre. An excellent report on the quality of the Ishan cotton was received from the ginnery at Lome in French Togoland.

22. KENYA. *Cotton Cultivation*, 1931-33. (*Ann. Rpt. Dpt. of Agr.*, 1932.) *Nyanza Province.*—The season 1931-32 was a good one for cotton, 2,166,253 lb. of seed cotton being obtained as compared with 918,967 lb. in the previous season. Prices averaged about Sh. 10 per 100 lb. at ginneries, with small fluctuations at buying centres.

Weather conditions were very favourable for the planting and growing of the 1932-33 crop, and a final return of 3,940,764 lb. of seed cotton was received.

Coastal Provinces.—The rainfall for the year was well above average, but the distribution was uneven. The cotton yield was good, some 627,886 lb. of seed cotton being obtained as compared with 29,500 lb. the previous season.

As the result of intensive propaganda a considerably extended cotton acreage was planted in 1932-33. The weather was not so favourable, and yields per acre were lower. The total yield was 978,034 lb. of seed cotton. The price paid was Sh. 9 per 100 lb. for first grade, but later the price fell to Sh. 8. The quality of the lint has much improved since the introduction of new seed in 1931.

Efforts are being made to extend cotton cultivation in Kilifi and Malindi districts.

23. NIGERIA. *Cotton Cultivation*, 1933-34. (*Half-yearly Rpt. of Dpt. of Agr. to September* 30, 1933.) *Northern Provinces.*—The demand for seed this season has been very keen indeed, and there has been a big increase in the acreage of cotton actually planted as compared with the area planted during the last three or four seasons. There is much less wastage of seed than formerly. Unfortunately the yield is likely to be below normal, as weather conditions have been unfavourable.

Southern Provinces.—Ishan seed was again sold at ¼d. per lb., and there was a much greater demand for seed than in the last two seasons. The total quantity sold was 66·6 tons and 4½ tons were distributed free of charge to farmers at Meko for multiplication. Judging by the cotton on Moor Plantation, which has made good growth and appears to be healthy, the yield should be at least up to average unless weather conditions later should prove unfavourable.

24. *Northern Provinces. Cotton Industry*, 1931-33. (*Ann. Rpt. of N. Provs.*, 1932.) Cotton purchases for the 1931-32 season in the Zaria and Katsina Emirates were the lowest for many years. The price ranged from ·6d. to ·9d. per lb. In the 1932-33 season there was a large increase in the area under cotton, and production figures showed a considerable increase over the previous season.

25. *Cotton Investigations.* (*Bull. Imp. Inst.*, xxxi., 3, 1933, p. 419.) From the report on the work of the Botanical Section, Southern Provinces, for the period January-June, 1933, we learn that the low yield of improved Ishan A Cotton during 1932-33 on Moor Plantation was due to exceptional drought conditions experienced shortly after planting, this view being confirmed by the high yield obtained from plots which were established early. The yield for the season was 392 lb. seed cotton per acre.

Cotton Breeding.—The elimination of a certain roughness in the lint of Ishan cotton, and at the same time the maintenance of the valuable agricultural characteristics for which this cotton is noted, continues the major problem in breeding and selection at Ibadan. This roughness was recognized early in the history of Ishan cotton selection, and Strain A was crossed with the smoother linted but otherwise less desirable Strain E. Eighteen strains of this AE cross were planted last season; of these eleven were discarded early, one after examination, and six were retained. Three of the most promising strains of those retained are now to be planted on a field scale for trial against Ishan A. A further attempt to improve the smoothness of Ishan lint was initiated in 1931, when, on Dr. Harland's advice, crosses were made between this cotton and Sea Island. The F_1 generations were planted in the selection plot and were back-crossed with Ishan A. Successive back-crossing is to continue. The five New Guinea Kidney × Sea Island strains proved quite unsuitable to Ibadan conditions, and these strains have been discarded.

The Agricultural Botanist, Northern Provinces, reports that Strain L, the

Allen selection which it is proposed to introduce into general cultivation this season, is being grown in the following stages of multiplication:

Breeding plot	Progeny of a single plant.
Isolation plot	3 acres (seed from 1932 breeding plot, all seed selfed).
Maigana farm	50 acres (seed from 1932 isolation plot).
Daudawa farm	500 acres (seed from 1932 plot at Maigana).
Dan Ja	Special area of native farmers, 4,000 acres (seed from 1932 crop at Daudawa).

The 1935-36 season should see this strain grown over the greater part of the cotton area of the Northern Provinces.

Breeding for Yield.—Previous to 1930 all efforts were concentrated on improving the quality of Allen cotton, but in that year a number of selections were made for yield, combined with average quality. Five of these selections were tested last season in a yield trial against Allen cotton, but failed to beat this variety. Other selections are being tested this season, and it is hoped that these will be more productive.

Crossing.—For some time it has been apparent that straightforward pure-line selection and the introduction of improved varieties from abroad were unlikely to produce any cotton superior to ordinary Allen or L, and it was decided to resort to hybridization. A beginning was made in 1932 by crossing various improved strains with one another, the following strains being used:

1. Strain L (an Allen selection) for general merit.
2. Strain C (an Allen selection) for length, hairiness, and yield.
3. H21 (Hartsville) for freedom from immaturity.
4. U4/123 for reputed freedom from immaturity and hairiness.

All possible crosses have been made except H21 × U4/123 and the reverse cross. The F_1 generation has been grown under irrigation during the dry season. This generation has been selfed, but the F_2 generation will be back-crossed with one or other of the parents.

Cotton in the Middle Belt.—The U4 and Coimbatore 2 cottons, which appeared promising in the 1931-32 season, were subjected to a more rigorous test in 1932-33. The results were not so promising and practically dispel any hope of introducing either of the varieties into general cultivation. A trial of selections from the local cottons against the local type at Yandev, Benue Province, produced no outstanding types.

26. PLANT BREEDING IN SOUTHERN NIGERIA. By E. H. G. Smith *et al.* (*Trop. Agr.*, x., **11**, 1933, p. 312.) A general review of the methods and progress of plant breeding in Southern Nigeria, including the work that has been done in connection with the Ishan strains of cotton.

27. SOUTHERN RHODESIA. *Some Notes from the Cotton Station, Gatooma.* By J. E. Peat. (*Rhod. Agr. J.*, xxx., **9**, 1933, p. 739.) An account of the work with improved U4 strains grown at Gatooma. U4/64 (Gatooma, No. 5) now represents the commercial seed stock of most of the growers; but as it is only one generation from the parent stock it is showing signs of segregation and a number of undesirable types are showing up. There are, however, several strains now at the observation-multiplication stage to replace it; among these U4/64/7/10 and U4/64/V have given the best results. Notes are included on spacing, fertilizing, and especially on pests. The most serious pests of cotton in Southern Rhodesia are the American bollworm (*Heliothis obsoleta*), Red, or

Sudan, bollworm (*Diparopsis castanea*), and Stainers (*Dysdercus* spp.), and investigation work on their habits and control is being continued.

28. TANGANYIKA. *East African Research Station, Amani.* (*5th Ann. Rpt.*, 1932-33.) Contains the usual reports of the Director, Plant Pathologist, Entomologist, Soil Chemist, Biochemist, Plant Physiologist, Plant Geneticist, Systematic Botanist, Superintendent of Plantations, and the Secretary and Librarian. The Director states that definite advances have been made along many lines of investigation, and although the programme of long-range research has been followed, some important results capable of immediate application have been reached by the way, especially in relation to the coffee and sisal industries. The laboratory supply services have functioned smoothly and without interruption, and the new road, since completion, has enabled a reliable transport service for all purposes to be maintained. The only disquieting feature of the year has been the unusual number of cases of malaria affecting members of the staff or their families. These have emphasized the difficulties of dealing with cases of illness in a small and isolated community.

29. UGANDA. *Cotton Cultivation*, 1932-33. (*Ann. Rpt. Dpt. of Agr.*, 1932, recently received.) The acreage planted to cotton for the first time exceeded 1,000,000 acres. Favourable weather conditions prevailed throughout the growing period. The area under S.G. 29 was further increased from 55,499 acres in 1931-32 to 144,581 acres in 1932-33.

The number of ginneries licensed to gin and bale cotton during the season was 123.

Ploughing has become well established in Teso and Bugwere, where the peasants have made rapid progress under the supervision of native instructors. An increase of 431 ploughs in Teso and 255 in Bugwere was recorded over the previous year. In Lango district, also, steady progress was made, and 570 men and 369 cattle were trained during the season. Lack of money and the limited number of suitable cattle available hindered progress in other districts.

The position with regard to locust invasion was more satisfactory than in 1931, and the damage to crops was negligible. Efforts to retard the spread of pink bollworm into the main cotton-growing areas of the Protectorate were continued by prohibiting the export of cotton seed and seed cotton from the Gulu and Chua districts, and by the establishment of a 5-mile no-cotton belt on the boundaries of the Gulu closed area.

30. *Cotton Prospects*, 1933-34. The latest report received from the Department of Agriculture states that the total acreage planted to cotton is 1,033,936 acres. Weather conditions during September were favourable in most areas, and prospects on the whole are satisfactory. Blackarm has been reported from Lango and Teso districts, and *Helopeltis* and jassid have been responsible for some injury to cotton in Bugwere district, but pests and diseases have not yet caused any serious damage.

31. AUSTRALASIA. QUEENSLAND. *Cotton Cultivation*, 1932-33. (*Dalgety's Ann. Wool Rev.*, 1932-33, p. 180.) Adverse weather conditions were experienced during the season, and a crop of only 12,000 bales was anticipated. In Central Queensland the rainfall was the lightest for sixty years. Negotiations were concluded between the Cotton Board and Australian Cotton Spinners whereby the latter definitely agreed to purchase 10,500 bales of cotton lint. As the season's yield was not expected to exceed 12,000 bales, the sale of this proportion of the crop would ensure to growers a profitable return for their seed cotton. In the Dawson and Callide Valleys the Unemployed Relief Council came to the assistance of growers by making loans available to those who were in necessitous circumstances.

32. Fiji. *Cotton Industry*, 1932. (*Ann. Bull. of Div. Rpts.*, 1932, recently received.) From the annual report of the Cotton Inspector we learn that owing to low prices the area planted to cotton was small. Seasonal conditions were unfavourable for cotton but were most suitable for rice, of which a bumper crop was produced. Prior to this there had been three consecutive bad rice reasons and local stocks were exhausted; cultivators, therefore, paid more attention to this crop and neglected the standing cotton which might have produced good yields. Notwithstanding unfavourable weather conditions, the lint produced was far superior to that of the past three years. This may be accounted for by the growers only harvesting the fully matured and best seed cotton, whereas in the years in which rice was scarce they picked all grades to the most inferior in order to obtain as much cash as possible.

During the year pink bollworm was more in evidence and there was some injury from boll-rot. There was an absence of stainers, and on the whole injury from pests and diseases was not so serious as in some years.

The ginneries at Lautoka and Sigatoka functioned satisfactorily.

Prospects for 1933.—Owing to the continued low prices Government decided to suspend planting on commercial lines for one year, and to plant only a sufficient area in 1933 to keep up a seed supply, and to concentrate on multiplication plots of the Cotton Specialist's back-cross variety, so as to be ready to advance with the back-cross when conditions are brighter.

33. *Report on the Cotton Experiment Station, Sigatoka*, 1932. (*Ann. Bull. of Div. Rpts.*, 1932, recently received.) The Cotton Specialist, Mr. Anson, reports that, in addition to the experiments carried out with the principal crop, cotton, work in connection with other crops which might prove of economic value to the Colony has been continued.

Seasonal conditions were unfavourable for cotton. The actual rainfall was at no time excessive, but the weather remained dull and sultry for so long that conditions were such that casual boll-rots played havoc with the cotton crop, and these atmospheric conditions seemed generally to encourage cotton pests, with the result that the yield was one of the poorest on record.

Cotton Experiments.—Varietal trials with Trinidad Red Kidney, Sea Island, Green Kidney, and Shambur cotton from the Sudan were carried out, but were not successful owing to severe jassid attack and boll-rot. Tests made with cotton following cowpea, peanuts, maize, mung and Mauritius bean showed that significantly higher yields were obtained from cotton which followed mung and maize.

New Guinea Back-cross and Re-selections.—During the season 1930-31, 500 progeny rows were planted from K2×SI and K3×S5. In the F_2 generations these were found to be splitting up for corolla spot as well as for other characters. In reselecting attention was paid only to plants which carried a heavier corolla spot than either parent, or those which had practically no spot. These two types were planted on isolated plots in the hope that plants which either carried the extra heavy spot or no spot at all might breed true, not only in spot colour and intensity but also in other characters. In the F_3s 30 per cent. of the deep-spotted ones bred true and 33 per cent. of the spotless ones, and it is from twelve of these progeny rows that increase plots are being planted during the coming season. Most of these selections have been planted in isolated centres averaging 4 acres in area, and should provide sufficient seed from any one selection for general distribution in this district in season 1933-34.

When making selections in a field of New Guinea back-cross a plant was discovered possessing flowers which did not open. The plant was labelled and kept under observation; at the end of one month's observation it was found that none of the flowers had opened, but bolls had set quite satisfactorily. Seed was collected

and planted, since if the progeny bred true to this peculiarity, it might be useful to have a variety of cotton which would be automatically self-fertilized. Fifty-six per cent. of the resultant plants inherited the closed flower habit, the remainder having either fully or partly opened flowers. The seed from these closed flower types has been sown this season in order to make a further test.

Fijian Agricultural Centres, Sigatoka.—The working of the agricultural scheme is described. With a view to stimulating commercial agriculture amongst Fijians agricultural implements and animals have been loaned to Fijian villages. A system of crop rotation has been inaugurated at each centre—a food crop, money crop, and pulse crop—and an efficient system of marketing adopted.

34. WEST INDIES. SEA ISLAND COTTON. (*W. India Comm. Circ.*, 14/9/33.) From a review of the trading during the 1932-33 season, by Messrs. Molyneux, Taylor and Co., of Liverpool, we learn that there was a more general enquiry from Home and Continental markets, and stocks were considerably reduced. From the shippers' point of view poor prices only were realized, and it is not anticipated that there will be a substantial rise until the prevailing depression has passed by. A definite fillip has been given to the trade by the advertising of Sea Island goods.

35. BARBADOS. *Cotton Cultivation*, 1932-33. (*Agr. J. of Dpt. of Sci. and Agr., Barbados*, ii., Nos. 1 and 2, 1933.) The depression in the Sea Island cotton industry is especially unfortunate for Barbados, since cotton is an ideal rotation crop for sugar-cane. The acreage planted for the 1932-33 season was 234 acres. Pink bollworm was observed in all cotton-growing areas, but caused only slight damage. The Peasant Cotton Plot Competition was held again during the year, and it is gratifying to record that the object of the competition has been fully realized, in that almost all cultivators adopted the method of planting recommended by the Department of Agriculture. A new Plant Pests and Diseases (Importation) Act was placed on the Statute Book in 1932, the object of the Act being to control the importation of seeds, plants, and planting material and to ensure the introduction of only healthy material into the island. During the year, also, some 7,086 bags of imported cotton seed were disinfected in the Simon's Heater, and the holds of fifteen ships were fumigated with Zyklon B.

36. MONTSERRAT. *Cotton Cultivation*, 1932. (*Rpt. on Agr. Dpt.*, 1932, recently received.) A badly distributed rainfall at sowing time caused many areas to be abandoned or considerably reduced, and the total acreage planted was estimated at 1,500 acres. The average yield was below normal as a result of the incessant rains and prevalence of pink bollworm. The general purity of the cotton-fields throughout the island was very good, and, with one exception, no off-type plants were recorded. No injury was caused by cotton leafworm or cotton bollworm, but a fair amount of damage was caused by green bug and pink bollworm. The Agricultural Department continued its efforts towards the improvement of the quality of the strain of cotton grown in the island, and the position in this respect appears to be satisfactory. After a detailed examination of the 1931 progeny rows, Dr. Harland advised the retention of only "M6." The lint and seed characters of this variety showed all-round improvement in 1932.

37. ST. KITTS, NEVIS, AND ANGUILLA. *Cotton Cultivation*, 1932-33. (*Ann. Rpt. of Agr. Dpt.*, 1932, recently received.) As a result of the unsatisfactory market for Sea Island cotton a considerably reduced acreage was planted in all three islands, and in addition the crop suffered severely from pink bollworm attack. Excessive rains interfered with the germination of the crop in Nevis, with the consequence that the plants made slow growth. Conditions improved later and

the crop promised to give a fair return, but this promise was dispelled by the early appearance of pink bollworm and stainer. Purchasing of the peasants' cotton was undertaken by the Government on the same lines as last season. An advance at the rate of 3 cents per lb. was paid on delivery of the cotton, and only clean Sea Island cotton was accepted. The lint was shipped to the British Cotton Growing Association and was sold at a price which allowed a bonus of 1·4 cents per lb. to the peasants.

COTTON IN EGYPT.

38. EGYPT. *Cotton Cultivation*, 1933-34. (*Man. Guar.*, 4/11/33.) The generally favourable weather experienced during late September and October resulted in good progress being made by the cotton crop, and the estimated production is 7,921,600 kantars. In Lower Egypt the yield is slightly lower than in 1932 for Sakellaridis, but higher for other varieties, while in Upper Egypt the yield averages about 20 per cent. more than last year.

39. TENDENCIES IN EGYPTIAN COTTON. (*Text. Weekly*, 13/10/33.) An outline, by Mr. Arno Pearse, of the Egyptian Government's new policy of concentrated effort to meet the demands of consumers by making available the right kinds of cotton as and when required.

40. A NEW SPINNING PLANT. (*Man. Guar. Coml.*, 30/9/33 and 11/11/33.) An experimental cotton-spinning plant is to be set up by the Egyptian Government Cotton Research Board at Giza. This is the second establishment of its kind in the world, the other being the experimental cotton-spinning plant set up in Bombay by the Indian Central Cotton Committee. Mr. H. A. Hancock, a scientist on the staff of the British Cotton Industry Research Association, will be in charge. Dr. Lawrence Balls states that the new station for carrying out spinning tests will not be located in an industrial area, but will be on the great experimental farm, and the spinning test staff will be able to have raw material provided for them according to their own prescription, so far as is humanly possible, in order to investigate their problems. The station is intended as an aid rather in the breeding of improved cottons than as an aid to more and better spinning in Egypt, and the help of consumers of Egyptian cotton is hoped for.

COTTON IN THE UNITED STATES.

41. COTTON CULTIVATION IN U.S.A. By E. H. Johnson. (*Cotton Trade J.*, Intern. Edn., 1933, pp. 12 and 82. Abstr. from *Summ. of Curr. Lit.*, xiii., **18**, 1933, p. 455.) The present distribution of cotton growing in the States is discussed, and a table is included showing the percentage of the total crop for 1903-7, 1925-32, grown in the South-East (Alabama, Georgia, and the Carolinas), the Mississippi Valley (Arkansas, Louisiana, Mississippi, and Tennessee), the South-West (Texas and Oklahoma), and the Irrigated South-West (California).

42. COTTON: CULTIVATION IN U.S.A. By J. T. Egan. (*Cotton Trade J.*, Intern. Edn., 1933. Abstr. from *Summ. of Curr. Lit.*, xiii., **18**, 1933, p. 455.) The author discusses the distribution by grade and staple of the American crop in recent years, and gives reasons for certain fluctuations. The classification by grade for 1931-32 is recorded as Extra White 2·6 per cent., Middling White and better 72·7 per cent., White Strict Low and Low Middling 14·4 per cent., White Standards below Low Middling 3·4 per cent., and Coloured (spots, tinges, and stains) 6·9 per cent.

43. AMERICAN COTTON-GROWING INDUSTRY: COMPETITIVE POWER. By J. T. Sanders. (*Cotton Trade J.*, Intern. Edn., 1933, pp. 28 and 89. Abstract from

Summ. of Curr. Lit., xiii., **18**, 1933, p. 455.) In answer to the question, " Can the world do without American cotton ?" the author surveys the possibilities in other countries.

44. AMERICAN COTTON CROP: REPORTING. By W. F. Callander and V. C. Childs. (*Cotton Trade J.*, Intern. Edn., 1933, p. 24. Abstr. from *Summ. of Curr. Lit.*, xiii., **18**, 1933, p. 455.) Describes the work of the Crop Reporting Board of the U.S. Department of Agriculture.

45. AMERICAN COTTON PRICE: FORECASTING. By B. Trapp. (*Cotton Trade J.*, Intern. Edn., 1933. Abstr. from *Summ. of Curr. Lit.*, xiii., **18**, 1933, p. 479.) The author describes a method of calculating the probable price of cotton by a correlation of five main factors—viz., (1) Supplies on hand (given by U.S.A. monthly statistics of exports and consumption), (2) expected supply (from U.S.A. crop reports), (3) demand (from Hester's data of spinners' takings), (4) business outlook (given by the percentage ratio to 1926 values of a large number of stocks and shares), and (5) the purchasing power of the dollar (given by the " All Commodities " price index). Notes are added on the statistical methods employed in the calculation, and the success of the method is indicated by a graph of actual and calculated prices for the past sixteen years.

46. ACREAGE REDUCTION—AND THE COST. By C. T. Revere. (*Man. Guar. Coml. World Textiles Supplement*, October, 1933, p. 7.) Deals with the difficulties encountered by the U.S. Government in its attempts to exercise supervision or control over the cotton acreage. The cost of the acreage reduction scheme is roughly estimated at $110,000,000.

47. AMERICAN COTTON IN 1932-33. By G. W. Fooshe. (*Man. Guar. Coml. World Textiles Supplement*, October, 1933, p. 5.) A very interesting account of American cotton in a season characterized by unusually wide price movements under the influence of decidedly conflicting forces, though, in the main, advances predominated, and a substantial portion of the ground lost in the two preceding seasons was regained.

48. THE AMERICAN COTTON IMBROGLIO, 1933-35. By W. Whittam. (*Text. Rec.*, li., **607**, 1933, p. 22.) The author states that the rise in commodity prices has not helped the American cotton farmer; there is confusion in policy on the price parity of U.S. cotton, and dissatisfaction with the Processing Tax. The official plan for limiting cotton acreage is discussed.

49. AMERICAN COTTON AND ITS RIVALS. By A. H. Garside. (*Man. Guar. Coml. World Textiles Supplement*, October, 1933, p. 9.) Deals with the problem of eliminating surplus supplies.

50. WORLD TEXTILES: WITH A REVIEW OF AMERICAN COTTON. (Published by *Man. Guar. Coml.*, October 7, 1933.) Contains, among others, the following interesting articles: " American Cotton in 1932-33 " (Fooshe); " Acreage Reduction—and the Cost " (Revere); " American Cotton and its Rivals " (Garside); " The Future of Staple Fibre "; " Cotton, Silk, and Rayon Machinery " (Hanton).

51. AMERICAN TEXTILE NOTES. By W. Whittam. (*Text. Rec.*, li., **607**, 1933, p. 66.) " In the matter of re-employment under the National Recovery Administration, the Labour Department places the increase in the number of workers employed in manufacturing in August over March as 1,500,000, and the total of new jobs of all kinds at 2,200,000, which indicates that the rate of re-employment in manufacturing is four times that of other occupations. In the textile mills of the South employment is reported as at its peak. Southern workers are discussing the lower minimum wages allowed them as compared with those in

the mills of the North. As a result of the active campaign for unionization of workers there will doubtless arise, sooner or later, a demand that all sections of the country (textiles) be placed upon the same wage footing, and that the higher one be the standard."

52. AMERICAN TEXTILE NOTES. By W. Whittam. (*Text. Rec.*, li., **606**, 1933, p. 68.) *A New Variety of American Cotton.*—Five years ago a South Carolina cotton grower first noticed a five-lock boll in one of his fields (four locks to a boll is usual). He and members of his family at once set out to pick every five-lock boll they could find. The seeds from these were planted, and field hands were paid extra to gather separately all five-lock bolls they could find, with the result that this season there were sufficient seeds of the new kind to plant 50 acres. So far this season about 85 per cent. of the crop picked from the 50-acre plot has been five-lock bolls. This new type, which yields by weight about 30 per cent. more lint than the usual four-lock kind, is also early ripening and blight proof.

53. AMERICAN COTTON INDUSTRY "CODE." (*Cotton*, U.S., 97, **7**, 1933, p. 22. Abstr. from *Summ. of Curr. Lit.*, xiii., **20**, 1933, p. 534.) Important features of the "Code of Fair Competition" are: a minimum weekly wage of $12 for all operatives, except learners, cleaners and outside employees; a maximum working period of 40 hours per week (except for repairers, engineers, cleaners, etc.); operation of machinery not to exceed two 40-hour shifts per week; no minors under 16 to be employed; and monthly or weekly reports on wages, hours of labour, machinery, production, stocks and orders, to be sent to the Cotton Textile Institute.

54. AMERICAN "CODES" AND INDUSTRIAL RECOVERY. By W. Whittam. (*Text. Rec.*, li., **606**, 1933, p. 23.) Deals with the American Cotton Processing Tax.

55. AMERICAN COTTON INDUSTRY CODE: OPERATION. (*Text. World*, **81**, 1933, p. 1412. Abstr. from *Summ. of Curr. Lit.*, xiii., **20**, 1933, p. 534.) The operation of the Code is discussed, and the belief is expressed that, in spite of difficult problems, the ultimate success of the movement is assured.

56. COTTON HARVESTING MACHINES: APPLICATION. By V. H. Schoffelmayer. (*Cotton Trade J.*, Intern. Edn., 1933. Abstr. from *Summ. of Curr. Lit.*, xiii., **18**, 1933, p. 456.) The author discusses the relation of mechanical harvesting to the price of cotton. In the days when cotton was 20-30 cents per lb. hand-pickers could earn about $5 per day, but last season they scarcely obtained $1. This provides a temptation to "snapping" the cotton, with consequent trouble to the ginner. A 500-bale is usually obtained from about 1,500 lb. of clean hand-picked cotton, but "snapped" cotton often takes 1,800-2,200 lb. to give a standard bale. In 1926 the practice of "sledding" was introduced. The cost of harvesting a bale of cotton was about $22 in the old days, $15 for "snapping" and $2·50 to $3·50 for "sledding." Against this fall the ginner has raised his price from $6 to $11 because of the extra difficulty of dealing with snapped and sledded cotton. The author is of opinion that improvements in mechanical harvesters will save the situation. Inventions can at present be divided into the following types: (1) Pickers with revolving spindles, fingers or prongs; (2) threshers that mow down the whole plant; (3) suction or air-blast devices; (4) electrical machines in which the cotton is attracted to a charged belt or fingers; (5) slotted or notched or revolving-roller strippers to take the entire stalk. Several machines are mentioned, and some are shown at work in the field.

57. California. *Cotton Cultivation*, 1933. (*S. Calif. Crops*, ix., **10**, 1933.) From this report we learn that September was a very unfavourable month for cotton growing in the south-west, in fact, the most unfavourable for several years, and as a result yields are expected to be below normal.

58. Outlines of Cotton Culture in the San Joaquin Valley of California. By J. W. Hubbard. (*U.S. Dpt. of Agr. Circ.*, **256**, 1933. Abstr. from *Exp. Sta. Rec.*, 69, **2**, 1933, p. 204.) Practical information is given on selection of land and seed, time of planting, stands, chopping, cultivation, root development in relation to irrigation, effects of irrigation, and on ripening in early crops.

59. Georgia. *Cotton Cultivation.* By E. C. Westbrook. (*Cotton*, U.S.A., **97** No. 6, 1933, p. 37. Abstr. from *Summ. of Curr. Lit.*, xiii., **16**, 1933, p. 413.) The author reports a survey of the staple and character of cotton grown or consumed in Georgia. Too much $\frac{7}{8}$ inch staple cotton is being produced and not enough $1\frac{5}{16}$ inch and longer staple. The quality of Georgia cotton has improved in the last five years, due to the planting of better seed. A table is given of cotton production and consumption in the State.

60. North Carolina. *Results of Cotton Variety Experiments*, 1930-32. By P. H. Kime. (*North Carolina Sta. Agron. Inform. Circ.*, **78**, 1933. Abstr. from *Exp. Sta. Rec.*, 69, **2**, 1933, p. 203.) Strains of Foster and Farm Relief cottons were recommended for the heavy and poorly-drained soil in the lower Coastal Plain, and for wilt-infested soils the best varieties were considered to be Dixie-Triumph, Dixie, and Clevewilt.

61. Oklahoma. *Cotton Prices.* By L. S. Ellis. (*Current Farm Economics*, Oklahoma, Ser. 49, Vol. VI., No. 5, 1933.) "The Oklahoma farm price of cotton had increased from approximately 5 cents per lb. during the last month of 1932 and the early months of 1933, to about 10 cents by mid-July this year. Thereafter the price declined to 8·7 cents by mid-August and to 8·2 cents on September 15. Until May of this year the purchasing power of cotton in Oklahoma had been at 50 or less ever since August, 1931, compared with an average of 100 for the period 1910-14. By the middle of July the purchasing power had climbed to 83, but declined to 69 in August and to 65 in September. Under present price conditions it would require a price of between 12 and 13 cents per lb. to give cotton a purchasing power of 100, or equal to that for the period 1910-14, which is the goal the new Agricultural Adjustment Act has set for those farmers who co-operate in the reduction of acreage."

62. Texas. *Cotton Cultivation.* By C. D. Brandt. (*Text. World*, **83**, 1258, 1933. Abstr. from *J. of Text. Inst.*, xxiv., **10**, 1933, A489.) Deals with cotton growing in the High South Plains region of Texas. The annual rainfall is about 20 inches; the growing season is short, about 200 days between frosts. Half-and-Half cotton does well, but the staple is only about $\frac{3}{4}$-$\frac{7}{8}$ inch. About 80 per cent. of the crop is harvested by "snapping."

COTTON IN FOREIGN COUNTRIES.

63. Brazilian Cotton Control. (*Times Trade Supplement*, 30/9/33.) Recent decrees of the Provisional Government provide for the official classification of all cotton grown in Brazil, and for Government control of the distribution of seed for planting. Instead of cotton being sold on the basis of weight only as hitherto, prices will be quoted according to weight and official standards of type and length of staple. Payments will be made against certificates issued by the Classification Departments of the Ministry of Agriculture to be installed in the various centres. These departments will also inspect all cotton in warehouses,

docks, and railway stations before issuing permits for its removal. The official control of the distribution of seed should do much to improve the quality of Brazilian cotton and protect the plantations from disease and insect pests.

64. Belgian Congo. *Cotton Cultivation.* (*Man. Guar. Coml.*, 18/11/33.) According to the chairman of the Belgian Colonial Cotton Committee, the development of cotton cultivation in the Belgian Congo can be regarded with optimism. The increase in production during the 1932-33 season amounted to 19,500 tons, or 2,000 tons more than the 1931 figure. Planting in the Uele and Maniema districts has been restarted at the demand of the natives, and although production costs are heavier than in more favoured districts, compensation has been found in a larger harvest. Practically the whole of the crop has been sold in Belgium at prices slightly above those of good American middling. The Belgian Congo has no cotton stocks.

65. Étude de Cotons du Cambodge. By Heim de Balsac and E. Roehrich. (*Coton et Cult. Cotonn*, viii., **1**, 1933, p. 29.) A brief discussion of cotton cultivation in Cambodia and of the characteristics of the new types developed from indigenous varieties. Technological reports are given of the four types No. 4, Short Pistil, Klay II (from Kompong Speu), and Klay II (from Petit Takeo Agricultural Station). These cottons are of good length, fineness and maturation. No. 4 should spin to 60's, Pistil to 50's, and the Klay strains possibly to 80's. Instead of being classed with American cottons, these varieties should be placed near Egyptian " Uppers " in "fully good fair." Another Cambodian cotton at present being cultivated gives a better yield, but is inferior in other characteristics.

66. Cotton Growing in Central Asia. (*Monthly Rev. Moscow Narodny Bank*, September, 1933.) Describes the work in connection with the expansion of cotton cultivation, and the collectivization of the peasantry.

67. China. *Cotton Industry.* (*Man. Guar. Coml.*, 18/11/33.) A commission is to be formed for the rationalization of the cotton industry in China, and to look after the disposal of the American cotton purchased from the United States under the special loan. Mr. K. P. Chen, managing director of the Shanghai Commercial and Savings Bank, has been asked to become president of the commission, and various other prominent leaders have been invited to join the organization with a view to developing the cotton industry of the country.

68. German Cotton Industry: Economics. By M. Biehl. (*Wirtschaftsdienst*, **18**, 1933, p. 880. Abstr. from *Summ. of Curr. Lit.*, xiii., **15**, 1933, p. 412.) Discusses the world position of raw cotton, wool, silk, and rayon, and the effect of restricted American production on world crops. Tables show the German supplies of raw textile materials in 1913 and from 1929-32, as well as world production from 1923-31. The working of cotton rags into new material (as in the case of wool) is as yet of little importance owing to the low price of the raw material, but the author suggests it might be considered as a means for finding productive, if uneconomic, employment.

69. Japanese Cotton Trade Costs. By B. Ellinger. (*Man. Guar. Coml.*, 27/3/33. Abstr. from *Summ. of Curr. Lit.*, xiii., **15**, 1933, p. 412.) (1) The author denies that Japanese competition in the cotton trade can be called "unfair," and presents tables of Japanese and Lancashire costs. Although Lancashire and Japan pay the same for raw cotton, and the non-labour costs are practically equal for both countries, yet Lancashire labour costs are from two to three times those of Japan, so that the relative costs of cotton goods from Lancashire and Japan are approximately 120 : 100. (2) The wages of Japanese female textile operatives,

which approximate to 10s. 6d. weekly, are compared with those of girls of corresponding ages (14-18) in other branches of British industry. There is not much difference in the wages, the English ones being in some cases as low as 5s. weekly. The loss of the cheaper end of the trade by Britain to Oriental countries might be remedied by using more young operatives at low wages, and putting them to weave very simple cloths suitable for the Eastern market.

70. Japanese Cotton Operatives: Physiological Research. By H. M. Vernon. (*Human Factor*, **7**, 1933, p. 178. Abstr. from *J. of Text. Inst.*, xxiv., **8**, 1933, A432.) A summary is given of a report by the Institute of the Science of Labour in Japan on investigations on women operatives in the Japanese cotton mills. It was found that night work threw a great deal of strain on the women, as was shown by observations of body weight. Industrial fatigue was found to increase the reaction times for sound, light, and discrimination. It was also shown that, whilst there was hardly any difference between the offspring of brain and manual workers at the age of 6, yet the poorer children were of lower mental age at 9 years than the more well-to-do, and that at 13 years and onwards their intelligence was stationary, whilst the well-to-do children improved till they were 17 years old. It is concluded that Japanese children ought to stay at school till they are 14 years old and should not start regular industrial work till they are at least 16.

71. Russian Cotton: Cultivation. By A. P. Demidov. (*Cotton Trade J.*, Intern. Edn., 1933. Abstr. from *Summ. of Curr. Lit.*, xiii., **18**, 1933, 456.) A short illustrated account of conditions in Turkestan and Transcaucasia. Two main varieties are grown, a native cotton called "Ghooza" or "Kara-Koza," with a staple of 20-22 mm., and an acclimatized American Upland, 75 per cent. of which has a staple of 27-29 mm. and is of good spinning quality. Farms are on a small scale, and the author has a poor opinion of the efficiency of the industry.

72. Russian Cotton Industry. (*Text. Weekly*, xii., **292**, 1933, p. 151.) Field work in Russian cotton areas this season, as in former years, has been below the level required for good cultivation. No estimate of the 1933 cotton area is available, but the plan for the current year called for 5,100,000 acres against 6,647,000 acres for 1932. Latest reports, however, indicate that only 5,890,000 acres were actually under cultivation in 1932. This year, the first cultivation of cotton was completed on practically the entire planted acreage, although apparently not always at the most desirable time. The second and third cultivations were much less satisfactory. Cultivation in newer cotton areas was reported as especially backward, with a consequently heavy growth of weeds in evidence. Insufficient use of, or lack of, machines, as well as an unsatisfactory policy of distributing advance payments among members of collectives, are cited as the chief reasons for the slow cultivation.

SOILS AND MANURES.

73. Contribution to our Knowledge of the Chemical Nature and Origin of Humus. I. On the Synthesis of the "Humus Nucleus." II. The Influence of "Synthesized" Humus Compounds and of "Natural Humus" upon Soil Microbiological Processes. By S. A. Waksman and K. R. N. Iyer. (*Soil Sci.*, 34, **1**, 1932. Abstr. from *Exp. Sta. Rec.*, 68, **2**, 1933, p. 163.) These two papers present. on the basis of extensive experimental data, the following among other observations and conclusions: Lignin was found to depress the rate of decomposition of protein, not from any toxic action, but as a result of the interaction of the lignin with the protein, which makes the latter more resistant to attack by micro-organisms.

A resistant complex of lignin and protein was synthesized in the laboratory. This complex was similar in physical appearance and possessed the various chemical, physico-chemical, and biological properties characteristic of the major portion of the soil organic matter, usually called humus or humic acid. It combined with such bases as calcium, magnesium, iron, and aluminium in a manner similar to that of the combination between soil humus and these bases.

The formation of a humus-nucleus complex establishes definitely the relation between the organic nitrogenous substances and the non-nitrogenous substances of the soil humus; this is responsible for the resistance of the soil nitrogen to rapid decomposition by micro-organisms. The formation of such a complex also suggests evidence to explain the more or less constant carbon-nitrogen ratio which exists in mineral soils.

The synthesized humus complexes favoured the decomposition of glucose by a mixed soil microbial population, especially in the absence of an added source of combined nitrogen. Like the natural soil humus, they could not supply the nitrogen needed by cellulose-decomposing micro-organisms, but they benefited decidedly the decomposition of cellulose in the presence of available combined nitrogen. The ratio between the cellulose decomposed and the nitrogen consumed by the micro-organisms decomposing the cellulose was not modified by the presence of humus complexes. Lignin did not depress cellulose decomposition; the effect was rather beneficial.

Lignin was found to lessen the rate of the decomposition of fungus mycelium, as measured by CO_2 liberation and NH_3 accumulation; a large part of the nitrogen of the mycelium could be isolated at the end of the experiment in the form of a ligno-protein complex. The influence of lignin upon the decomposition of casein was similar.

Calcium ligno-proteinate has a favourable effect upon the decomposition of the fungus mycelium, as measured by both CO_2 evolution and ammonia accumulation. The hydrogen ligno-proteinate, however, had a slightly injurious effect, possibly due to its acid reaction. The synthesized humus complexes containing iron had a highly beneficial effect upon the fixation of nitrogen by *Azotobacter*.

74. Causes of Low Nitrification Capacity of Certain Soils. By G. S. Fraps and A. J. Sterges. *Soil Sci.*, 34, **5**, 1932, p. 353. Abstr. from *Exp. Sta. Rec.*, 68, **6**, 1933, p. 737.) A large number of samples of soils did not nitrify ammonium sulphate when examined at the Texas Experiment Station, though they usually produced some nitrates from the soil nitrogen. Such soils did nitrify ammonium sulphate after the addition of cultures of actively nitrifying soil, of calcium carbonate, or of both nitrifying culture and calcium carbonate. It is further stated that approximately one-half of the seven surface soils which did not nitrify ammonium sulphate could be made to nitrify effectively by adding calcium carbonate, and the other half by adding both calcium carbonate and soil cultures containing actively nitrifying bacteria. "Of the 19 subsoils which did not nitrify ammonium sulphate, 2 assumed a high nitrifying power by additions of bacteria alone, 1 by addition of carbonate, and 16 by addition of both calcium carbonate and bacteria in a nitrifying culture."

Sterilized soil cultures of low calcium carbonate content caused no nitrification. Inoculating liquids produced little nitrification and are not considered a satisfactory means of adding nitrifying organisms to a soil. The amount of nitrate production increased in general with the quantity of the inoculant culture within the range 0·1 to 20 g. added to 200 g. of sterilized soil, but "not in direct proportion to the number of bacteria added," and the authors did not find it possible to measure the number of bacteria added directly by the quantity of nitrates produced.

Nitrites were sometimes produced from ammonium sulphate when nitrates were not. Nitrites were in some cases produced from ammonium sulphate after the addition of calcium carbonate with but little concomitant production of nitrates.

"The quantity of nitrites from ammonium sulphate in a sterilized soil was found to be highest when 0·1 g. of inoculant was used to 200 g. of sterilized soil, and decreased with a greater amount of inoculant, until, with 2 g. of inoculant, practically no nitrite remained. Nitrite organisms are either more abundant in the soil than nitrate organisms or else they multiply more rapidly. The total production of nitrites, as measured by the sum of the nitrous and nitric nitrogen, is not in direct proportion to the numbers of organisms added. The first addition of 0·1 g. of culture to 200 g. of soil produces a high quantity of nitrites plus nitrates, whereas subsequent increments produce much smaller quantities."

75. STUDIES ON THE CARBON AND NITROGEN CYCLES IN THE SOIL, IV.-VIII. (*J. Agr. Sci.*, xxii., 1932. Abstr. from *Rpts. for* 1931 *and* 1932, Rothamsted Experimental Station, Harpenden, Herts.) The fourth of this series of papers from Rothamsted (by M. M. S. du Toit and H. J. Page) deals with the preparation of natural and artificial humic acids. The fifth paper (by H. J. Page) supports the hypothesis that the humic matter of the soil is derived from lignin, and emphasizes the importance of studying the part played by nitrogen in the formation of soil humic matter. The sixth paper (by R. P. Hobson and H. J. Page) deals with the extraction of the organic nitrogen of the soil with alkali. The seventh and eighth papers of the series (by R. P. Hobson and H. J. Page) deal with the nature of the organic nitrogen compounds of the soil—"humic" nitrogen and "non-humic" nitrogen.

[*Cf.* Abstr. **403**, Vol. X. of this Review.]

76. SOIL BACTERIA CAPABLE OF ASSIMILATING NITRATES. By P. E. Brown and F. S. Smith. (*J. of Amer. Soc. of Agr.*, Geneva, N.Y., xxiv., **9**, 1932, p. 749. Abstr. from *Int. Rev. Agr.*, xxiv., **7**, 1933, p. T319.) It is known that the addition to soil of straw, maize stalks, or other plant waste with a high carbon-nitrogen ratio usually has the effect of reducing the content of the soil in nitric nitrogen, as it enables certain micro-organisms to assimilate the nitrates. Since nitrates are thus removed from the higher plants on the land the phenomenon may be of great practical importance, for if it occurs to any large extent it may seriously affect certain crops. The conditions favouring the assimilation of nitrates by soil micro-organisms have been studied to some extent, but there has been no complete study of the organisms having this capacity. This gap has recently been filled by the authors. They isolated from soils in which this assimilation was taking place species belonging to the genera *Azotobacter*, *Aerobacillus*, *Pseudomonas*, and *Achromobacter*, and then grew them in pure culture, and found that all these micro-organisms are capable of assimilating nitrates.

77. DETERMINATION OF NITROGEN IN SOILS, II. By A. Srinivasan and V. Subrahmanyan. (*Ind. J. of Agr. Sci.*, iii., **5**, 1933, p. 646.) Deals with the protective action of silica as a factor in the estimation of nitrogen by the Kjeldahl method.

78. A METHOD FOR DETERMINING COMBINED WATER AND ORGANIC MATTER IN SOILS. By G. Bouyoucos. (*Soil Sci.*, 34, **4**, 1932, p. 259. Abstr. from *Exp. Sta. Rec.*, 68, **6**, 1933, p. 727.) Apparatus for the determination of combined water is described in this contribution from the Michigan Experiment Station. This apparatus consists essentially of a distillation bomb made from iron pipe, closed at one end and provided at the other with a thread fitting

an iron cap carrying a brazed-in short piece of ½-inch pipe to which is brazed a 2-foot length of ⅛-inch copper tubing cooled by a short condenser of lead pipe through which the copper tubing is soldered; together with a narrow cylinder graduated to 0·1 c.c. in which the water to be measured is collected over a layer of carbon tetrachloride. The bomb illustrated has a capacity of 250 c.c., and samples of 100 g. are used. Distillation is effected in an electric muffle furnace at 800° C. in the case of mineral soils, and at 330° C. in that of peats or mucks. The distillation was found to be completed in about 15 minutes. Accuracy trials showed a recovery of from 9·9 to 10 c.c. out of 10 c.c. of water added to previously ignited samples of various soil types.

Of the determination of organic matter it is noted that "because the combined water can be determined, the ignition method now becomes more accurate and reliable for determining the organic matter in soils."

79. Cotton Plant: Effect of Calcium Arsenate on Growth. By (1) W. R. Paden, (2) W. B. Rogers. (*Proc. Ass. Southern Agr. Workers*, **33,** 1932, pp. 29-31. Abstr. from *Summ. of Curr. Lit.*, xiii., **19,** 1933, p. 481.) (1) Calcium arsenate was found to depress the growth of cotton on one coarse sandy loam when applied at the rate of 50 lb. per acre. Another sandy loam tolerated 250 lb., and a clay loam 2,000 lb. Liming appeared to increase tolerance to arsenic. (2) Similar studies are reported. Iron sulphate proved a good corrective to arsenic injury.

80. Cotton Plant: Effect of Limestone on Growth. By R. P. Bledsoe. (*Proc. Ass. Southern Agr. Workers*, **33,** 1932, p. 36. Abstr. from *Summ. of Curr. Lit.*, xiii., **19,** 1933, p. 481.) In the Piedmont region of Georgia addition of ground limestone to mixed fertilizers markedly increased the yields and stands of cotton when acid-forming nitrogen (urea, ammonium sulphate or phosphate) was used. Nitrate-nitrogen sources gave better yields than ammonia-nitrogen sources, both with and without limestone. In the Coastal Plain region, addition of limestone to the fertilizer caused a decrease in yield or no marked increase in some cases, whereas in other cases increases were obtained.

81. Cotton Plant: Salt Tolerance. By M. T. Ruizhenkova. (*Chemization Socialistic Agr.*, **8,** 1932, p. 47. Abstr. from *Summ. of Curr. Lit.*, xiii. **19,** 1933, p. 481.) The salt concentration in the first 10 cm. of the soil is of primary importance during the process of germination; 1·5 per cent. salt concentration was found to be injurious, but up to 0·9 per cent. concentration no injury was noted. For the normal growth of cotton the salt concentration of the first 50 cm. of soil is a determining factor. The sulphates of sodium and magnesium were found to be just as injurious as the chlorides. Gypsum, at the rate of 0·4 per cent., does not depress the growth of the cotton plant but reduces the yield. Egyptian cotton was found to be more sensitive to salt concentration than American cotton.

82. Limits to the Use of the Neubauer Method of Analysis. By A. Hock. (*Das Superphosphat*, No. 8, Berlin, 1932, p. 217. Abstr. from *Int. Rev. Agr.*, xxiv., **7,** 1933, p. T318.) Soil reaction plays a decisive rôle in the matter, at the extremes of acidity and alkalinity, but in normal conditions the rye seedlings employed in the Neubauer method are not affected.

83. Cotton Plant: Effect of Fertilizers on Lint Length. By E. B. Reynolds and D. T. Killough. (*Proc. Ass. Southern Agr. Workers*, **33,** 1932, p. 36. Abstr. from *Summ. of Curr. Lit.*, xiii., **19,** 1933, p. 481.) There was no consistent relation between staple length and the rates of application of nitrogen, potassium, phosphorus, or complete fertilizers, although in some cases significant differences in length occurred among the fertilizer treatments.

84. Effect of Soil Fertility, Boll-Maturation Period, and Early or Late Production of Bolls on the Length of Cotton Fibres. By G. M. Armstrong and C. C. Bennett. (*J. Agr. Res.*, 47, **7**, 1933, p. 467.) Small plants growing on plots of low fertility, and clearly suffering from malnutrition, produced lint of practically the same length as that produced by vigorous plants growing on plots of high fertility, though the uniformity of distribution of the different lengths was less in the poorly nourished plants. The lint from bolls produced from blooms that were among the last to be retained, namely, those of August 21, was from $\frac{1}{16}$ to $\frac{2}{16}$ inch shorter than that from bolls arising a week earlier, on August 14 and 15. Bolls from blooms opening on the same day, but with a maturation period of 75·1 days, had a larger percentage of short fibres than those with a maturation period of 58 days, though the practical lint length was the same. The variability in lint length and the distribution of the different length groups was about the same in bolls of a first crop and in those of a second crop produced on the same plants.

85. Fertilizers and Crop Production. By Dr. L. L. van Slyke. (Orange Judd Pubg. Co., New York, 1932. Price $4.00. Abstr. from *Bull. Imp. Inst.*, xxxi., **3**, 1933, p. 461.) This book is written with a view to the needs not only of students in agricultural colleges, but also of the practical farmer whose main concern is with the immediate production of crops on a profitable basis. It is divided into five parts, each containing several chapters. The first part deals with the factors affecting soil fertility, and gives a simple outline of the elementary facts of chemistry needed for comprehension of the rôle played by the various elements and compounds essential to plant nutrition. The second part is concerned with the functions and physical properties of the soil; the third section deals with the various materials used as direct plant foods and as indirect fertilizers and soil amendments. The fourth part enumerates the factors which must be considered in selecting fertilizers, and the most effective method of use. The final section deals with the application of fertilizers to the growing of specific crops, and contains much valuable information in somewhat condensed form. The book as a whole forms a storehouse of useful and practical information for farmers in America and in other countries with similar climatic conditions.

86. Les Engrais Chimiques en Égypte. By J. Anhoury. (*Bull. de l'Union des Agriculteurs d'Égypte*, **238**, 1933. Abstr. in *Coton et Cult. Cotonn.*, viii., **1**, 1933, p. 49.) Fertilizer experiments are described.

87. Use of Farm Wastage. (*Sun of S. Afr.*, August, 1933.) Describes a system of making compost from farm wastage.

CULTIVATION, IRRIGATION, GINNING, USE OF SEED, ETC.

88. Experimentation and Applied Statistics for the Practical Agriculturist. By D. D. Paterson. (*Trop. Agr.*, x., **10**, 1933, p. 267, and subsequent numbers.) The object of the paper is to give, in a form easily assimilated, a brief account of some of the more commonly adopted plot arrangements used in field experiments, and to describe for each a statistical method that will give a valid interpretation of the yield data. It is believed that such information would be welcome to many in Colonial Agricultural Departments who have found modern statistical theories rather elusive and confusing, but who will require some knowledge of the basic principles for the proper execution of their official duties. The paper does not in any way purport to be a monograph on modern experimental statistics, and is not intended for the statistician or experienced experimentalist.

89. Application of Modern Statistical Methods to Field Trials. By R. D. Bose. (*Agr. and Livestock in India*, iii., **4**, 1933, p. 330.) The purpose of this paper is to impress on the minds of agricultural workers throughout India the importance of modern methods of field experiments. The various sections deal with accuracy and precision, soil heterogeneity, replications, size and shape of plots, randomization, lay-out of field trials and their interpretation.

90. The Formation of Latin Squares for Use in Field Experiments. By F. Yates. (*Empire J. of Exper. Agriculture*, i., **3**, 1933, p. 235.) The conditions which must be fulfilled in selecting Latin-square arrangements for agricultural field trials, if an unbiased estimate of error is to be obtained, are discussed. Examples of squares up to size 12×12 are given, from which experimental arrangements may be derived by simple processes of permutation. All squares up to size 6×6 have been enumerated elsewhere, and the totalities of these squares are presented here in compact form.

91. The Use of Delinted Cotton Seed for Planting Purposes. By L. Hodge. (*Queens. Agr. Jour.*, xl., **1**, 1933, p. 37.) It would appear from the experience gained during the past two or three seasons, and from investigations conducted at the Cotton Research Station at Biloela, that the use of delinted cotton seed for planting purposes ensures quicker germination, more even distribution of seed, and better ultimate stands than are obtained from planting undelinted seed.

This is illustrated in the following experiment: One side of a two-row drill was planted with delinted seed, while the other side was sown with undelinted seed, both at the rate of 20 lb. per acre. The test covered 1 acre sixteen rows wide. From the sixth to the twelfth day inclusive, after sowing, population counts of the resulting stand were made. The subjoined table shows the comparative rate of germination between the two treatments, expressed as the percentage of the *possible* germination daily and the final stand per foot obtained in each:

Seed.	*6th Day.*	*7th Day.*	*8th Day.*	*9th Day.*	*10th Day.*	*11th Day.*	*12th Day.*	*Plants per Foot.*
Delinted	49·1	65·2	69·4	72·4	73·8	75·2	76·3	4·5
Undelinted	7·9	25·7	33·9	40·9	44·9	49·6	52·3	2·0

92. A Physiological Study of Delayed Germination in Cotton. By R. Balasubrahmanyan and V. R. Mudaliar. (*Madras Agr. J.*, 1933, **21**, p. 147. Abstr. from *Plant Breeding Abstracts*, iii., **4**, 1933, p. 163.) The poor and late germination in the F_2 from an interspecific cross of cotton led to this investigation of the physiological aspects of the problem. The initial material consisted of three species and two hybrids. About 4 per cent. of the resulting hybrids lacked embryos, in the rest the embryo was not dormant but only reduced in vigour.

93. Cotton Seed: Influence on, of Exposure to High-Voltage X-rays. By C. N. Moore and C. P. Haskins. (*Bot. Gaz.*, **94**, 1933, p. 801. Abstr. from *Summ. of Curr. Lit.*, xiii., **19**, 1933, p. 502.) The results indicate that abnormal mitoses, correlated with considerable genetic changes, are involved.

94. Cotton Seed: Effects of Sulphuric Acid Delinting on. By A. H. Brown. (*Bot. Gaz.*, **94**, 1933, p. 755. Abstr. from *Summ. of Curr. Lit.*, xiii., **19**, 1933, p. 481.) Delinting the seed with sulphuric acid gives an increased rate of germination. The successful optimum duration of the delinting process was 5 minutes for long staple Upland varieties. Yields from mature plants derived from delinted seed exceeded those from undelinted by an average of 21·3 per cent. under the same field conditions.

95. Effects of Plant Spacing and Irrigation on Number of Locks in Cotton Bolls. By A. R. Leding and L. R. Lytton. (*J. Agr. Res.*, xlvii., 1, 1933, p. 33.) The results are reported of experiments carried out from 1926-29 on the effects of spacing and irrigation in the proportion of 4- and 5-lock cotton bolls produced. It was found that closer spacings consistently produced higher proportions of 4-lock bolls. A restricted water supply also resulted in the production of more 4-lock bolls, but the effect was not so great as that of crowding the plants. Graphs and tables are included expressing the experimental results.

96. Cotton-Ginning Investigations of the U.S. Department of Agriculture. By N. A. Olsen. (*Cotton*, M/c., 14/10/33 and 21/10/33.) In 1930 a special grant was made by Congress to enable cotton-ginning investigations to be carried out with a view to effecting improvement in the ginning of the American cotton crop. Experts from the Bureaux of Agricultural Engineering and Agricultural Economics were entrusted with the work, which was designed to "discover the fundamental laws and to develop the basic principles of cotton conditioning, cleaning, extracting, and ginning, and to promote a more exact understanding of relationships between (1) the characteristics, properties, and conditions of seed cotton, and (2) the mechanical aspects of ginning processes, on the one hand, and the resulting quality and quantity of ginned lint on the other hand."

A new cotton-ginning laboratory was erected for the purpose of the investigations at Stoneville, Mississippi, and a description is given of this building and its equipment.

Much valuable information has already been obtained in connection with the ginning of damp or wet cotton, the use of seed-cotton driers, the cleaning of cotton, etc., and several patents have been granted by Government covering important developments in drying processes, drying mechanism, and air-blast ginning.

A preliminary survey of over 700 representative gins throughout the cotton belt has resulted in the accumulation of many important facts in regard to gin machinery, gin organization and operative practices, power charges, and cost of ginning.

97. Cultivation Machinery. We have received from Messrs. Ransomes, Sims, and Jefferies, Ltd., four pamphlets containing good descriptions and illustrations of the very wide range of ploughs, cultivators, harrows, and other implements manufactured by them. Interesting photographs showing the ploughs and implements at work in various countries are also included.

98. Plantation Machinery and Equipment: Baling Presses. (*Crown Colonist*, iii., 24, 1933, p. 529.) Deals briefly with both the vertical and horizontal types of baling press.

DISEASES, PESTS, AND INJURIES, AND THEIR CONTROL.

99. Egypt. *Report on the Work of the Plant Protection Section during the Period* 1925-31. (Pubd. by Min. of Agr. Egypt, 1933.) In connection with the cotton industry, it is stated that the six years under review witnessed a considerable tightening up of the inspection and control of seed treatment in the ginning factories. All have now been equipped with one of the standard machines required for this purpose, and also, since 1930, with machines for treating the cotton gin refuse which was found to contain infective material.

Studies on cotton pests were continued. In regard to the major pest—pink bollworm—it is not considered that an early maturing crop will entirely avoid the attack of this pest, though it may do so to a certain extent. Arising from the threatened locust invasion of 1927, a special branch was formed in 1928 to study locusts and grasshoppers. The life histories of these pests have been worked out,

and an account is given of the control measures employed against them. The (Fusarium) wilt disease of cotton also formed the subject of investigation, and detailed work led to a full identification and description of the morphology and physiology of the fungus, and its differences from other strains in various parts of the world.

100. SUDAN. *Report of the Government Entomologist*, 1932. (*Wellcome Trop. Res. Labs. Bull. No.* 36, Ent. Section, 1933.) The year under review was not a very serious locust year when compared with the three previous seasons. The damage caused by these pests and the control measures employed are discussed. The pink bollworm caused much injury to cotton in Berber Province, but was not a pest of importance in Dongola Province. Sudan bollworm was prevalent in certain districts; preliminary trials were carried out at Shendi to trap the moths by means of light traps, but the results obtained by this method were poor. Damage by stainer was considerably less than in previous years in the Talodi district, this being attributed to the success of the control measures, which consisted of spraying infested *tebeldi* trees with paraffin and then setting light to them, while other trees were pollarded and the fruits collected and burnt. In other districts where no campaign against this pest was undertaken much damage was caused. Mr. J. W. Cowland, Entomologist in charge of the Gezira Entomological Section, reports that studies were continued on the life-cycle and habits of the white-fly and in connection with the leaf curl disease of cotton. Mr. W. L. P. Cameron continued his researches on cotton thrips, and also commenced work on the insects attacking cotton buds, which included *Heliothis obsoleta*, *H. peltigera*, and *Frankliniella dampfi*.

101. ASPETTI ENTOMOLOGICI DELLA COLTURA DEL COTONE NELLA COLONIA ERITREA. By A. Chiaromonte. (*Agr. colon.*, xxvii., **6**, Florence, 1933, p. 289. Abstr. from *Rev. App. Ent.*, xxi., Series A, **9**, 1933, p. 440.) Lists are given of the various pests attacking the different parts of the cotton plant, with notes on their presence or absence in the colony of Eritrea.

102. NOTES ON THE RED BOLLWORM (*Diparopsis castanea*, HMPSN.) OF COTTON IN SOUTH AFRICA. By A. J. Smith. (*Sci. Bull.*, *No.* 114, Dpt. of Agr. S. Afr., 1933.) A study of this pest, describing its appearance and life-history, nature of injury to cotton plants, the parasites that attack it, and the control measures that are or can be employed. Detailed tables of records of incidence, pupation, etc., are included.

103. FACTORS INFLUENCING THE ACTIVITIES OF THE COTTON BOLLWORM MOTH (*Heliothis obsoleta*). By J. C. Gaines. (*J. of Econ. Ent.*, xxvi., **5**, 1933, p. 957.) Continued observations on the activities of the cotton bollworm moth show that the growth of the cotton, as indicated by the plant height and fruiting, are factors that influence the moth and egg population. The migratory habits, time of flight, and proportion of sexes are also discussed.

104. INSECT ENEMIES OF THE CORN EARWORM (*Heliothis obsoleta*). By T. F. Winburn and R. H. Painter. (*J. Kansas Ent. Soc.*, v., **1**, 1932, p. 1. Abstr. from *Exp. Sta. Rec.*, 69, **2**, 1933, p. 242.) In a study of the literature at the Kansas Experiment Station, a list of 47 references to which is included, 82 species of insects were found recorded as enemies of the corn earworm. Those most important in the Kansas region are the egg parasites *Trichogramma minutum*, Riley, and *Telenomus heliothides*, Ashm., the larval parasite *Microplitis croceipes*, Cress., and the predacious bug *Orius insidiosus*, Say. The parasitism of the earworm on corn is very small, showing that a parasite is needed which has a long ovipositor or habits which will enable it to reach the corn earworm larvæ in spite of the protecting shucks. At the station two new insect enemies of the corn earworm were found—viz., *Chrysopa plorabunda*, Fitch, and *Microplitis*, sp., near *melianæ*, Vier.

105. EXPERIMENTS WITH BAITS FOR THE CONTROL OF CERTAIN COTTON PESTS. By D. O. Atherton. (*Queens. Agr. J.*, xl., **3**, 1933, p. 183.) Experiments with liquid poison bait were carried out with a view to obtaining a practicable method for the control of the corn earworm (*Heliothis obsoleta*) on cotton. The baits included molasses and water and honey and water syrups, with the addition of various other substances such as sodium arsenite, kerosene, aqueous extract of quassia chips, amyl acetate, and ethyl acetate. Half the pails containing the liquids were placed on stands 2 feet from the ground, and the remainder on the ground. The baits were not effective against corn earworm, but a syrup of molasses and water containing sodium arsenite at the rate of 0·5 oz. per gallon showed promise as a bait for cotton looper moths. Out of a total of 4,141 moths of all species captured only 159 were of the corn earworm, whereas there were 2,131 green looper moths and 1,851 others, including brown cutworm, rough bollworm, and *Sericea spectans*.

106. EXPERIMENTS IN THE CONTROL OF THE CORN EARWORM, *Heliothis obsoleta*, FABR., WITH *Trichogramma minutum*, RILEY. By R. K. Fletcher. (*J. of Econ. Ent.*, xxvi., **5**, 1933, p. 976.) Studies in the dispersion of *Trichogramma minutum* in cornfields, and two experiments in the control of the corn earworm (*Heliothis obsoleta*) with *Trichogramma minutum*, are described.

In neither case was the number of *Trichogramma* released per acre sufficient to give control of the corn earworm.

107. CUTWORM CONTROL. By R. Veitch. (*Queens. Agr. J.*, xl., **3**, 1933, p. 180.) A short description of the brown cutworm and its control by means of poison bait.

108. A SUSPECTED SOUND-PRODUCING ORGAN IN *Empoasca devastans*. By C. J. George. (*J. of Univ. of Bombay*, i., **5**, 1933, p. 54.) An anatomical description of the organ.

109. THE EFFECT OF CERTAIN HOMOPTEROUS INSECTS AS COMPARED WITH THREE COMMON MIRIDS UPON THE GROWTH AND FRUITING OF COTTON PLANTS. By K. P. Ewing and R. L. McGarr. (*J. of Econ. Ent.*, xxvi., **5**, 1933, p. 943.) Three years of cage experiments with four homopterous insects (*Homalodisca triquetra*, *Oncometopia undata*, *Graphocephala versuta*, and *Stictocephala festina*), showed that none of these species, when allowed to feed on cotton plants, was able materially to reduce the normal production of fruit of the plants, or cause typical hopper damage, as did three species of mirids (*Psallus seriatus*, *Lygus pratensis*, *Adelphocoris rapidus*).

110. A STUDY OF THE COTTON FLEA HOPPER, WITH SPECIAL REFERENCE TO THE SPRING EMERGENCE, DISPERSAL, AND POPULATION. By J. C. Gaines. (*J. of Econ. Ent.*, xxvi., **5**, 1933, p. 963.) The population of the cotton flea hopper, *Psallus seriatus*, Reut., is increased by rainfall which produces a rapid growth of the host plants. Early fall rains which promote the growth of fall weeds are influential in determining the numbers of insects that emerge the following spring. Time of spring emergence and dispersal are factors that influence the population in cotton.

111. DAMAGE TO THE COTTON PLANT CAUSED BY *Megalopsallus atriplicis*, KNGT., AND OTHER SPECIES OF MIRIDÆ. By R. L. McGarr. (*J. of Econ. Ent.*, xxvi., **5**, 1933, p. 953.) Experiments have proved that *Megalopsallus atriplicis*, when allowed to feed on cotton, causes blasting or abortion of the young squares, and induces swellings and lesions on the stems and petioles and malformation of the leaves; and that *Psallus biguttulatus*, *P. pictipes*, *Reuteroscopus ornatus*,

Lygus cristatus, *Megalopsallus latifrons*, and *Melanotrichus leviculus* cause swellings and lesions on the stems and petioles similar to those produced by *Psallus seriatus*.

112. OBSERVATIONS ON THE DESERT LOCUST IN EAST AFRICA FROM JULY, 1928, TO APRIL, 1929. By C. B. Williams. (*Ann. App. Biology*, xx., 3, 1933, p. 463.) The author gives the following summary. Two broods were observed to develop between May, 1928, and April, 1929. Females slightly outnumbered the males in a number of random collections of adults. A list of plants eaten or avoided by the adults is given, including species from 62 natural orders, of which 18 are represented by both edible and inedible species. Notes on the food plants of the hoppers are also included. Hoppers of the fourth and fifth stages were observed to have a maximum speed of about ¼ mile per hour. The chief natural enemies were *Stomatorrhina lunata*, a Dipterous parasite of the egg, and *Sphex ægyptiacum*, a predator on the adult locusts. The latter had developed a migratory habit and followed its host. No regular relation between direction of flight and direction of wind was observed. Trekking activity in swarms of hoppers of the fourth and fifth stages was most noticeable when the air temperature was above 15° C. Feeding was most general when the air temperature was above 10° C., and in the swarms observed, which were probably short of food, took place at almost any hour of the day. Continual observation of one band of hoppers throughout a whole day showed that the direction of movement was by no means constant; in fact, two complete circles were made in the course of the day. Adult locusts were found to orientate head towards the sun when the black-bulb temperature was 130° F. or above. Adult locusts were found to be insensitive to sounds such as the banging of tin cans (often used for scaring purposes) or the firing of a gun, but were much frightened by the noise of a file drawn down the edge of a saw. Railway trains were got through swarms of egg-laying adults on the ground by having several boys running in front of the train at short intervals. This procedure frightened the locusts off the line and was much more successful than any system of brushes in front of the wheels. A few small-scale experiments with poisoned bran showed no difference in effectiveness between sodium arsenate and sodium fluosilicate. A few individuals from a swarm of just-hatched hoppers were kept in isolation until the last larval stage, but did not assume the pale colouring of the solitary phase. Dissections of adult females showed that the ovaries remained small (about 11 mm. long) as long as the locusts remained purple-brown in colour.

113. THE LOCUST OUTBREAK IN AFRICA AND WESTERN ASIA, 1925-31. By B. P. Uvarov. (*Econ. Adv. Coun. Comm. Locust Contr.*, London, 1933. Abstr. from *Rev. App. Ent.*, xxi., Series A, 8, 1933, p. 401.) The present outbreaks of *Schistocerca gregaria*, Forsk., in Africa and Western Asia and of *Locusta migratoria migratorioides*, Rch. and Frm. and *Nomadacris septemfasciata*, Serv., in Africa, are discussed from their known beginnings, the developments being followed from season to season for each region separately and illustrated by a series of maps. The information summarized in this way forms the basis for a discussion of the breeding areas and seasons and migration routes of each species, and the factors regulating them. As the main result of the survey, a clear general idea has been obtained of the breeding areas and migrations of the three species, each of which has definite requirements. The breeding and migrations are regulated primarily by climatic conditions, and the original breeding centres are few in number and probably limited in extent, but the swarms arising from them spread over enormous distances. The problem, therefore, is an international one, and can only be solved by the discovery of the original breeding areas, which could then be kept under constant observation for the suppression of incipient outbreaks.

It is pointed out that since under subtropical and tropical conditions the egg and the hopper stages are of short duration, and the adult stage usually lasts much longer, the present methods of control directed mainly against hoppers must give way to those directed against the adults. Amongst them, the dusting of flying swarms from aeroplanes is advocated.

Appendices contain suggestions for bioclimatic observations and a list of books and papers on the locust and grasshopper problem published in 1926-31.

114. NOTES ON THE BIOLOGY AND CONTROL OF THE RED LOCUST IN SOUTHERN RHODESIA, 1932-33. (*Rhod. Agr. Jour.*, xxx., **10**, 1933, p. 791.) Part I. (R. W. Jack) deals with the control of locusts by mechanical and chemical means, and by utilization of natural enemies and diseases. Part II. (M. C. Mossop) deals with the life history of the Red Locust (*Nomadacris septemfasciata*).

115. SELENIUM: INSECTICIDE MATERIAL FOR CONTROLLING RED SPIDER. By C. B. Gnadinger. (*Indus. Eng. Chem.*, xxv., **6**, Easton, Pa., 1933. Abstr. from *Rev. App. Ent.*, xxi., Series A, **10**, 1933, p. 565.) Control measures in use against Tetranychid mites in the United States are briefly discussed, the species involved including *Tetranychus telarius*, which has nearly 200 known food plants, and causes losses estimated at £400,000 a year to the cotton crop. In greenhouse tests the most suitable compound was found to be selenium dissolved in potassium ammonium sulphide solution in proportions corresponding to the formula $(KNH_4S)Se_5$. A 30 per cent. solution of this material, designated Selocide, was submitted to a large number of tests against different mites. At a dilution of 1 : 200 with 0·4 gm. soap per 100 c.c., it controlled *Tetranychus telarius* without injury to the tender greenhouse plants.

116. THE BIONOMICS AND CONTROL OF *Dysdercus* (HEMIPTERA) IN THE SUDAN. By F. G. S. Whitfield. (*Bull. Ent. Res.*, xxiv., **2**, 1933, p. 301. Abstr. from *Rev. App. Ent.*, xxi., Series A, **9**, 1933, p. 484.) Of the four species of *Dysdercus* that are important pests of rain-grown cotton in the Sudan—*Dysdercus fasciatus*, *D. superstitiosus*, *D. nigrofasciatus*, and *D. cardinalis*—the first occurs in the northern rain belt and the other three in the southern. The bolls are first attacked when half-grown and slightly over 1 inch in diameter. Secondary damage is caused by fungi and bacteria that enter through the stylet punctures. The gravity of the infestation is seldom appreciated until yellowing of the lint in open bolls becomes apparent.

The life cycles of the pests are described, their lengths, in some cases at least, depending on temperature and humidity as well as on food available. *D. cardinalis* and *D. superstitiosus* are found breeding on *Sterculia cinerea* as well as on cotton, while the natural food plant of *D. fasciatus* is the baobab tree (*Adansonia digitata*), from which it migrates to the cotton during the cotton season. None of these species has a true resting period, adverse conditions merely inhibiting reproduction or even causing death. There are no natural enemies of any importance, but certain Reduviids, chiefly *Phonoctonus lutescens*, Guer and Perch., attack the nymphs and adults, and the Tachinid, *Bosgosiella pomeroyi*, Villen., attacks the three southern species in one district.

Among the control measures tried in experimental areas since 1930 against *D. fasciatus*, spraying the baobabs with commercial kerosene about ten days after the cutting and burning of the cotton stalks (which is a legally compulsory measure) killed most of the bugs. An ideal control measure would be the eradication of the baobab, but as these trees have some economic value, this is probably impossible. Failing this, the destruction of the cotton stalks should be carried out as early as possible, at least by the end of March; all infested baobabs should be cut back after spraying, and the fruit on the ground and on the trees should be collected and burned; small shrubs and trees within a radius of 30 feet from

the tree trunks should also be cut down, and all the débris should be piled round the tree trunks, sprinkled with kerosene after the trees have been sprayed, and then set alight, the hot flames reaching every part of the adjacent ground and every hiding-place effectively.

117. NORTHERN RHODESIA. *Cotton Stainers.* By C. J. Lewin. (*Ann. Rpt. of Dpt. of Agr., N. Rhod.*, 1932.) Seasonal distribution studies of the cotton stainer over the last three years have shown that three species are concerned in the transmission of internal boll rot—viz., *Dysdercus superstitiosus*, *D. fasciatus*, *D. intermedius*, and to a lesser extent the Pentatomid, *Callidea dregei*. *D. superstitiosus* appears first in the field when flowering commences, and is responsible for damage to the early crop, while *D. fasciatus* appears later and causes the large amount of staining found in the late crop. *D. intermedius* and *Callidea dregei* are not so important and have not been studied in the same detail. The percentage of the mature crop stained was 62·4 in 1931 and 35·4 in 1932. The baobab (*Adansonia digitata*) and *Thespesia rogersii* are alternative food plants. The normal annual food plants appear to be *Hibiscus* spp., of which by far the most abundant is *H. cannabinus*. Considerable numbers of *D. superstitiosus* were found from January to June, 1932, over large areas of pure stands of *H. cannabinus*, and it is possible that the relative scarcity of this stainer on cotton in 1932 was due to its attraction to Hibiscus. Experiments have shown that cotton-seed traps and hand-picking, either alone or in combination, are of no practical value for the control of stainers, and in several instances it was found that, in spite of the removal of large numbers (170,000 from 1 acre in one case), no reduction in damage as compared with untreated areas was observed.

118. THE TSETSE PROBLEM. (*Trop. Agr.*, x., **9**, 1933, p. 237.) An interesting account of what is being done to control this pest, more especially in Nigeria and Tanganyika.

119. TSETSE: A BARRIER TO PROGRESS IN EAST AFRICA. By C. E. Lane. (*Crown Colonist*, iii., **24**, 1933, p. 513.) A discussion of the problem and the measures of control, and stressing the need for additional funds to carry the work further.

120. TASK-WORK *v.* DAY-WORK METHODS IN ANTI-TSETSE CLEARINGS. By S. Napier-Bax. (*Trop. Agriculture*, x., **9**, 1933, p. 249.) Experiments showed that better results were obtained with task-work methods, which were more popular with the natives, but it was necessary to guard against making the tasks too large.

121. SOME ASPECTS OF VIRUS DISEASE IN PLANTS. By J. Henderson-Smith. (*Emp. Jour. of Exp. Agr.*, i., **3**, 1933, p. 206.) It is suggested that we are again on the upward curve of an increase in virus diseases. Leafcurl in the Sudan is instanced as a new disease unknown eight years ago. The questions of classification of viruses, specificity of host plants, and other points are considered. Much work remains to be done, but the author is of opinion that the virus problem is far from insoluble, and given adequate opportunities, results will be obtained which will justify the labour and thought and outlay they may cost.

122. AN EXPERIMENT ON THE INCIDENCE AND SPREAD OF ANGULAR LEAFSPOT DISEASE OF COTTON IN UGANDA. By C. G. Hansford, H. R. Hosking, R. H. Stoughton, and F. Yates. (*Ann. App. Biol.*, xx., **3**, 1933, p. 404.) Experiments on the incidence and spread of the angular leafspot disease of cotton, carried out at two centres in Uganda, are described. Treatment of the seed by sterilization with sulphuric acid and mercuric chloride resulted in a reduction in the amount of the disease throughout the season. Treatment of the seed with a bactericidal

dust had a significant effect on total germination, the plots sown with this seed having a greater number of plants at the end of the season, independently of those killed by the disease. Primary infection was almost entirely limited to plots sown with seed inoculated with the organism. Spread of the disease occurred in a direction down the slope of the ground and along the lines of surface wash. The implications of the experiment are discussed and proposals made for modifications in technique.

123. BACTERIAL GUMMOSIS OF COTTON IN THE TAMAN PENINSULA, ACCORDING TO OBSERVATIONS IN 1931. By Mme. E. S. Kwashnina. (In Russian, with English summary.) (*Bull. N. Caucasian Inst. for Plant Prot.*, Rostoff-on-Don, i. (viii.), 2, 1933. Abstr. from *Rev. App. Mycol.*, xii., 8, 1933, p. 507.) This is a detailed account of a generalized bacteriosis of the cotton plant which was very prevalent in 1931 in the newly established cotton fields in the Taman peninsula. The disease (which has been attributed to *Bacterium malvacearum* and some other forms) affected the cotyledons, stems, petioles, leaves, and bolls, producing symptoms which are described and are stated to resemble closely those associated with angular leafspot and black arm of cotton, including a severe boll and lint blight. The epidemic outbreak of the disease in 1931 is chiefly ascribed to the exceptionally wet weather which prevailed from May to September, the total rainfall for that period being 341 mm. as compared with the local normal average of 131·5 mm. From September onward, as the weather became more settled, the incidence and severity of new infections decreased, with the result that the later pickings of the crop were considerably healthier than the earlier.

Field observations in several localities indicated the existence of varietal differences in the relative resistance to the disease of 26 varieties of American Upland cottons (*Gossypium hirsutum*) which were experimentally grown, although none of them was completely immune. In this group the varieties 1306, 2013, and 182 were the least severely attacked by the stem and boll forms of the disease, which are stated to be the most destructive under the local conditions. Varieties of *G. herbaceum*, as a class, showed considerably greater resistance, and some of them gave indications of complete immunity.

There was further evidence that sowing cotton on autumn-fallowed soil tended to reduce the incidence of early infections. Tests with various manures showed that applications of a fertilizer containing phosphorus and potassium reduced the incidence of the disease from 83·5 per cent. in the control to 31·3 per cent., while applications of a nitrogenous fertilizer reduced the percentage of attack to 25·6. The use of relatively resistant varieties—*e.g.*, Upland 1306—may also tend to minimize the losses.

124. LA STIGMATOMYCOSE DES GRAINES DU COTONNIER. By A. Maublanc. (*Coton et Cult. Cotonn.*, viii., 1, 1933, p. 15.) The internal boll rot disease of cotton is due to *Spermophthora gossypii*, *Eremothecium cymbalariæ*, *Ashbya gossypii*, and *Nematospora coryli* fungi. The symptoms of the disease, the damage caused, and control measures are discussed. A useful list of literature is included.

125. THE DISTRIBUTION OF THE GENUS *Phytophthora*. By C. M. Tucker. (*Miss., Agr. Exp. Sta. Res. Bull.*, 184, 1933. Abstr. from *Rev. App. Mycol.*, xii., 10, 1933, p. 594.) This is an annotated list, arranged in alphabetical sequence of the natural order of the host, of all the species of *Phytophthora* which have been recorded in literature to occur on 216 species (in 149 genera and 67 families) of cultivated and wild plants. It also includes 82 additional species (45 genera and 6 families) on which the fungi have been successfully inoculated. Most of the *Phytophthora* species are recorded under the names reported by their authors,

except when the non-validity of such names has been clearly established. The bulletin terminates with a bibliography covering 524 titles and a page index of the hosts mentioned.

126. GROWTH OF THE COTTON ROOT-ROT FUNGUS IN SYNTHETIC MEDIA, AND THE TOXIC EFFECT OF AMMONIA ON THE FUNGUS. By D. C. Neal *et al.* (*J. Agr. Res.*, xlvii., **2**, 1933, p. 107.) The cotton root-rot fungus, *Phymatotrichum omnivorum*, was grown in Duggar's solution for fungi, and growth comparisons were made of five inorganic sources of nitrogen. With the nitrogen equivalents used at a concentration to yield approximately 12·4 g. of nitrogen per litre, very little growth of the mycelium appeared after intervals of 11, 18, and 31 days with ammonium nitrate or ammonium sulphate, whereas with calcium nitrate, sodium nitrate, and potassium nitrate, abundant growth was produced. Growth characters of the fungus obtained with the various nitrogen sources are described, and the toxic action of ammonium compounds is discussed. With the exception of the cultures supplied with ammoniacal nitrogen, pH exponents of the filtrates increased as growth of the fungus progressed. The probable cause of the shifting of hydrogen-ion concentration of the media is given. The apparent toxic effect of ammonia on the fungus was confirmed by subsequent tests, the mycelium being killed with ammonium hydroxide at a concentration as low as 500 parts per million after an exposure of 20 minutes. Gas liberated from 28 per cent. ammonia water also killed the mycelium in 30 seconds. Ammonia inhibited germination of root-rot sclerotia after exposures as short as 10, 15, and 20 seconds. Sclerotia were killed in 5 minutes by 1 per cent. solutions of ammonium hydroxide Growth of the mycelium from root tissues of infected cotton plants was prevented by exposure to ammonia for 1 minute in laboratory tests. In field tests 6 per cent. solutions of ammonium hydroxide applied to the soil around the roots of infected cotton plants killed the mycelium in most cases, whereas abundant growth developed from the checks. In experiments conducted in the field to determine the effect of ammonium hydroxide on cotton plants, it was found that mature plants were not killed with 4 or 6 per cent. solutions, although the cortical and cambium tissues of the roots were injured. The lethal effect of 8 per cent. solutions, however, was pronounced. The inhibiting effect of ammonia on growth of the fungus and the probable relation this may have to actual control of the disease through continued applications of barnyard manure are discussed. The possible utilization of ammonia or ammonium compounds for the control of the disease in cotton fields and for protecting ornamental plants is suggested by the experiments reported.

127. PERSISTENT STRANDS OF THE ROOT-ROT FUNGUS IN TEXAS. By H. McNamara *et al.* (*Science*, N.S., lxxvii., **2004**, 1933, p. 510. Abstr. from *Rev. App. Mycol.*, xii., **10**, 1933, p. 628.) Examination showed that the fungus overwinters in the soil mainly as strands rather than as sclerotia. The strands were mostly found among old, dead roots and plants killed by them a year before, or earlier. The growth of the hyphæ produced from the ends of old strands was characterized by radiating or parallel development of elongated cells which anastomose freely in the early stages. Later these structures were replaced by the more typical acicular hyphæ with rectangular branches. The older strands consist of an outer cortical ring of thick-walled, irregular cells enclosing large, elongated, thin-walled, septate cells. In contrast to the more deeply seated infections of the far south-west, the strands at Greenville, Texas, were found to be most abundant in the surface foot of soil, where they are relatively accessible to tillage operations or disinfectants.

GENERAL BOTANY, BREEDING, ETC.

128. Memoirs of the Cotton Research Station, Trinidad. (Pubd. by the Empire Cotton Growing Corporation. Price 2s. 6d. post free.) The fourth number of Series B, Physiology, has recently been issued, and contains the following paper reprinted from the *Annals of Botany*:

Studies on the Transport of Carbohydrates in the Cotton Plant: III. The Polar Distribution of Sugar in the Foliage Leaf. By E. Phillis and T. G. Mason. 1. The sugars found in the foliage leaf of the cotton plant include the hexoses, glucose and fructose, sucrose, and an unknown polyglucoside. The polyglucoside is present only in very small amounts in the petiole and in the vein. In the stem tissues it appears to be absent. It is soluble in water and in 80 per cent. alcohol. It seems to possess considerable reducing power, which is approximately doubled on hydrolysis. It, or some similar substance, has been found in the leaves of a number of other plants.

2. It is concluded that sucrose is the chief form in which carbohydrates travel from the assimilating cell to the phloem of the bundle-ends and anastomoses, and also longitudinally through the phloem to the stem, etc. The grounds for this conclusion are: (*a*) It is the only sugar to show well-marked and consistent diurnal changes in the lamina and in the petiole, and these changes are accompanied by similar changes in the rate of transport; (*b*) the response in lamina and in petiole to interrupting transport by ringing the stem is much more rapid and more marked for sucrose than for the other sugars; and finally (*c*) on darkening isolated leaves there is a rapid loss of sucrose from the lamina and a gain by the petiole. Glucose also disappears from the lamina, but much more slowly than sucrose. Fructose and the polyglucoside are less affected by darkening.

3. Estimates were made of the concentrations of sucrose in the phloem of the petiole and of the stem. These estimates indicate that the longitudinal sucrose gradient in the phloem is positive, and that consequently the concentration in the phloem of the fine veins is even higher than in the phloem of the petiole. As the sucrose concentration in the phloem of the petiole is about ten times as great as that in the mesophyll, it is inferred that the concentration in the phloem of the fine veins is enormously greater than that in the mesophyll. Estimates of the sucrose concentration in the fine veins lend support to this inference, and point to a sudden change in sucrose concentration between the mesophyll and the fine veins.

4. That sucrose is accumulated by the phloem of the fine veins from the mesophyll against a gradient of *mobile* sucrose is demonstrated by the observation that not only is the actual gradient negative, but the diurnal fluctuations in sucrose concentrations are much greater in the phloem than in the mesophyll. Moreover, when export from the leaf is checked by ringing the stem, the increase in concentration in the phloem is greatly in excess of that in the mesophyll.

5. Evidence that interchange of sugar between mesophyll and vein is polarized is supplied by an experiment in which a small proportion of the leaves on a plant were darkened. It was found that sugar entered much more readily into the veins than into the mesophyll of the darkened leaves.

6. As movement of sugar from mesophyll to phloem must occur mainly in the region of the fine veins with their single-layered border parenchyma, and as the phloem here consists predominantly of transition cells, it is suggested that these elements are peculiarly associated with the polar accumulation of sucrose and its release into the sieve-tube. It is suggested that the function of the companion cells, which are essentially indistinguishable from transition cells, is also to accumulate sucrose from the adjacent parenchyma and release it into the sieve-tubes.

129. THE CLINGING POWER OF COTTON AND THE NUMBER OF CONVOLUTIONS PER CENTIMETRE. By R. L. N. Iyengar. (*Ind. J. of Agr. Sci.*, iii., 2, 1933, p. 320.) The following conclusions are presented by the author: (1) When the same pair of pads is used for testing all the samples: (*a*) The clinging power is a maximum when the fibres tested and those that form the pads are derived from the same sample. (*b*) If the convolutions in the two are different there is always a fall in the clinging power; this fall increases with increasing difference irrespective of the sign. (*c*) The elimination of the variation in fibre-weight will make the results agree better with the conclusions enunciated above.

(2) A possible consequence of the above-mentioned conclusions may be that the strength of soft twisted yarns tends to increase if cottons possessing nearly the same number of convolutions are selected for mixing.

A similar effect of such a mixing on the spinning value, as determined by the highest standard warp count, is also noticeable, but the conclusion is not always true.

(3) When the fibres in the pads and those tested are derived from identical samples, the clinging power bears no relationship to the convolutions, which probably accounts for the fact that no correlation has so far been obtained between the yarn-strength and the convolutions.

130. NEW HIGH-BRED VARIETIES OF COTTON IN THE CAMPAIGN TO RAISE THE PRODUCTIVITY AND QUALITY OF COTTON. By J. D. Nagibin. (*Za vysokii urozai khlopka* (For high cotton yield), p. 115, Tashkent, 1933. Abstr. from *Plant Breeding Abstracts*, iv., 1, 1933, p. 66.) The importance of efficient seed production and control in connection with the introduction of high-bred varieties is emphasized.

131. PROGRESO DE MEJORAMIENTO DEL ALGODON DE LA VARIEDAD "PIMA." (*Circ. No.* 19, Estacion Experimental Agricola de La Molina, Lima, Peru, 1933.) Describes the progress made in the improvement of Pima cotton and the selection methods in use—viz., mass selection and individual selection.

132. DIFFERENCE IN PEROXYDASE ACTIVITY OF THE COTTON SPECIES. By S. Nakatomi. (*Proc. Crop. Sci. Soc.*, iv., p. 295, Japan, 1932. Abstr. from *Plant Breeding Abstracts*, iv., 1, 1933, p. 66.) The intensity of peroxydase action is much greater in Old World cotton with 26 chromosomes than in New World cotton with 52. Different species with the same number of chromosomes do not differ greatly in their peroxydase activity. In crosses of two parents with different chromosome complements the peroxydase activity of the F_1 is either intermediate or the degree of intensity of one or other parent is dominant.

133. GENETICS AT THE SERVICE OF SOCIALISTIC AGRICULTURE. By N. I. Vavilov. (*Bull. App. Bot.*, Series A, 4, p. 19. Leningrad, 1932. Abstr. from *Plant Breeding Abstracts*, iv., 1, 1933, p. 22.) The new genetic and breeding work of the last few years in the Soviet Union is compared with that in capitalist countries. Schemes for the next Five Year Plan are outlined, first with reference to definite problems, then as regards the general principles involved. Great emphasis is laid on the linking up of breeding and genetic work, on the need for co-operation and systematization, and the necessity for having the whole diversity of existing forms rather than isolated fragments of a species available for breeding. This is illustrated by reference to immunity to disease, drought and cold, earliness (ideas on which have been revolutionized by Lyssenko's work on vernalization and the new discoveries in photoperiodism), chemical composition of the plant, fibre qualities, capacity to benefit from artificial manures, quantitative characters, etc. The inadequacy of present knowledge is emphasized and desirable lines of study are indicated.

Among the general problems under investigation that of distant hybridization is one of the most stressed. Various breeding problems whose main hope of solution lies in interspecific hybridization, and a number of cases in which success has been attained on these lines, are mentioned. Among the methods of achieving success are artificial chromosome duplication and triple hybridization by use of a third species having the same chromosome number as the sterile hybrid, and with which the latter is compatible. The use of very large quantities is essential when applying the method of wide crosses, and cytological study is indispensable. Still greater advances are expected from crosses of geographically separated races or species not differing in chromosome number, whereby wide variation and the appearance of a number of new characters and combinations of characters are attained without the attendant difficulties of sterility.

The problems of inbreeding, heterosis, artificial mutations, "Daumermodifikationen," chimæras, the factors influencing sex and fertility and their control, the nature and behaviour of the gene, and the origin of species and forms, are pointed to as worthy of further study and application.

134. THE PRINCIPAL CHANGES INTRODUCED BY THE REVOLUTION INTO THE DIVERSITY OF THE CULTIVATED PLANTS. By P. M. Zhukovsky. (*Bull. App. Bot.*, Series A, **4**, p. 57. Leningrad, 1932. Abstr. from *Plant Breeding Abstracts*, iv., **1**, 1933, p. 36.) The introduction of new early-maturing Egyptian varieties, new methods of accelerating ripening and the opening up of new regions highly suitable to cotton cultivation, and the discovery of a method of vegetable reproduction whereby high-yielding though sterile F_1 hybrids can be cultivated, have all contributed to the recent success of cotton production.

135. METHODS FOR PRESERVING PLANTS IN THEIR NATURAL FORM AND COLOUR. By A. G. Seif-el-Nasr. (*Tech. and Sci. Serv. Bull. No.* 124. Min. of Agr., Egypt, 1932.) Deals with the preservation of plant material by wet or dry methods.

136. OBSERVATIONS SUR LA SELECTION DU COTONNIER D'ÉGYPTE EN ALGÉRIE. By P. Laumont and M. Isman. (*C. R. Ass. Franc. Av. Sci.*, **54**, p. 639, 1930. Abstr. from *Plant Breeding Abstracts*, iv., **1**, 1933, p. 66.) The work started with pedigree selection based on vigour, earliness, weight of seeds, lint index, lint length, ginning percentage and tenacity, fineness and extensibility of lint. Some of the selections combine higher yield with finer, altogether better lint than the ordinary Algerian cottons, some of them measuring only 16μ. The lines are kept pure by bagging. A description is given of the characters and performance of one of the best selections, No. 26, from Pima.

FIBRE, YARN, SPINNING, WEAVING, ETC.

137. FIBRE LENGTH IRREGULARITY IN COTTON. By N. Ahmad. (*Tech. Bull.*, Series B, No. 16. Ind. Cent. Cott. Comm., 1933.) The importance of regularity of staple, besides its length, has long been recognized by the spinners and other practical men engaged in the textile industry. Hitherto, with one recent exception, no objective method has been put forward for determining the staple irregularity of a cotton from experimental data. The object of this paper is to suggest such a method, to apply it to a large number of cottons tested at the Technological Laboratory, and to examine the results obtained with reference to their chief fibre properties and spinning performance. It is pointed out that the most rational way of calculating the fibre-length irregularity of a cotton would be to base it upon some property indicative of its length, and reasons are advanced for selecting for this purpose the modal in preference to the mean fibre-length. Accordingly the fibre-length irregularity is defined as the percentage ratio by

weight of all the fibres in a representative sample which measure less than three-fourths of the modal length.

Values of fibre-length irregularity, calculated according to the method described above, are given for 63 Standard Indian cottons and 30 agricultural samples. The results for the Standard cottons and the simple correlation coefficient between mean fibre length and irregularity show that the comparatively long cottons have a tendency to be somewhat more irregular than the short ones. This, however, is not always the case, and the anomaly completely disappears when we consider the results and the correlation coefficient for the agricultural samples, which cover a much wider range of fibre properties than the Standard cottons.

Values of simple and multiple correlation coefficients between the highest standard warp counts, the mean fibre length, the fibre weight per inch, and fibre-length irregularity are given for both series of samples, and their inter-relationships are discussed. It is found that the inclusion of fibre-length irregularity does not raise the multiple correlation coefficient between the highest standard warp counts and mean fibre length and fibre weight per inch. It is pointed out that this correlation is already so high (0·906 for the Standard cottons and 0·937 for the agricultural samples) that unless a fibre property be compatible in importance with length and weight, its effect in modifying the correlation coefficient is likely to be small.

The present method is compared with an earlier one, described by Clegg, for calculating a similar property called "percentage short hairs."

138. SOME FACTORS INFLUENCING THE VARIABILITY IN LENGTH OF COTTON FIBRES ON INDIVIDUAL PLANTS AS SHOWN BY THE SORTER METHOD. By G. M. Armstrong and C. C. Bennett. (*J. Agr. Res.*, 47, 7, 1933, p. 447.) Cotton fibres from all bolls on individual plants have been arrayed by the use of Baer and Johannsen sorters, which allow an accurate separation of the different lengths into groups by weight. A difference of $\frac{6}{16}$ inch in the practical staple length of the cotton classer has been found between the fibres of two bolls located rather close together on a plant. Very appreciable differences in the uniformity of distribution of the fibres of various lengths have also been shown. In terms of the staple length of the cotton classer, a difference of $\frac{3}{16}$ inch in length was found between the lint from seed of one locule and the same difference between the lint from bolls developing from blooms of the same day; $\frac{5}{16}$ inch was the difference in length of lint from blooms of two successive days. Conditions seemed to be favourable for the production of long lint in bolls from all flowers during certain periods of time. During certain short intervals, however, conditions seemed very unfavourable, as relatively short lint was produced. The position of the boll along the vertical axis or the horizontal axis does not seem to be of very great importance in determining the length of lint, though there is a distinct tendency for shorter lint to be produced near the top of the plant when grown in the field. Studies have been made of halo length, seed surface area and volume, boll volume, number of fibres per seed after 25 days of seed development, unit fibre weight, and sorter distribution of fibres in bolls at approximately 4-day intervals from 25 to 50 days of age. The increase in surface area of the seed was most rapid from about 10 to 18 days of age. The relative increase in seed volume and boll volume was about the same after 10 days, when the boll cavity becomes filled with developing seed and lint. The halo had practically reached full length in 25 days, though not absolutely so in 30 days. There was no evidence of an increase in the number of fibres per seed after 25 days. The unit fibre weight was not constant, the shorter fibres showing the greatest weight per inch. The shorter distributions of fibres from

bolls at approximately 4-day intervals from 25 to 50 days of age indicate that many of the fibres continue to elongate after the boll is 25 days old.

A literature list of 25 titles is given.

139. COTTON HAIR: INFLUENCE OF OPENING AND CLEANING MACHINES ON STRUCTURE. By E. Lipowsky. (*Textilber*, 14, 1933, p. 383. Abstr. from *Summ. of Curr. Lit.*, xiii., 19, 1933, p. 485.) Numbers of convolutions and hair thickness were determined for cotton hairs taken from samples of raw cotton and from the resulting card sliver. In another series of tests these characteristics, together with breaking loads and extensions, were determined for groups of hairs classified according to length, taken from opener and scutcher laps and from the original untreated cotton. The results show a decrease in number of convolutions and practically no change in thickness during processing. A decrease in strength also occurs in processing, particularly in scutching. The relation between length and strength and the variations observed in individual groups are discussed. Strengths, extensions and thicknesses are plotted against number of convolutions, and strength-thickness and extension-thickness curves are also given and discussed.

140. THE FOUNDATION OF YARN STRENGTH AND YARN EXTENSION. V. THE PREDICTION OF THE SPINNING VALUE OF A COTTON FROM ITS FIBRE PROPERTIES. By A. J. Turner and V. Venkataraman. (*Tech. Bull.*, Series B, No. 17, Ind. Cent. Cott. Comm., 1933.) Previous work is discussed, particularly certain suggested relationships between spinning value and staple length alone or in conjunction with fibre strength, and also between spinning value and fibre weight; reference is also made to two other suggested methods of attacking the problem on quite different lines.

Criteria for judging spinning value are discussed, and the criterion finally adopted is the highest standard warp count.

The tests at the Technological Laboratory are described for (1) spinning value, (2) length, (3) weight per inch, (4) ribbon width, (5) strength, (6) convolutions, (7) rigidity, and (8) clinging power. The results are given for two series: Series I., in which properties (1) to (7) were determined for 95 samples, and Series II., in which properties (1) to (8) were determined for 45 samples of Indian cottons. From these results the attempt has been made to derive prediction formulæ for spinning value in terms of the fibre properties by means of the method of correlation. This method is briefly explained, together with some of its limitations.

The accuracy of the prediction formulæ has been tested by comparing the actual spinning values with those calculated from the fibre properties by the aid of the formulæ. Finally, various anomalies between the actual and predicted spinning values are discussed, and a number of reasons advanced to explain them, and to indicate the lines along which future research might profitably be directed.

141. MEASURING MOISTURE IN COTTON BALES BY ELECTRICAL CAPACITANCE. By W. L. Balls. (*Int. Cott. Bull.*, xi., 44, 1933, p. 460.) This Egyptian Government publication was prepared in order to give those members attending the 16th International Cotton Congress who were interested in a specialist subject some information regarding the investigations made during the past eighteen months.

After showing the need for a rapid means of estimating the moisture content of every bale, the author gives the essential facts concerning bale moisture, about the relation of cotton to moisture, and about the influence of this moisture on the dielectric " constant " of cotton. He then describes how, designing his

method to fit the limitations imposed by the conditions of work in a pressing establishment, it is possible to use the hoops of the bales as if they were the plates of a condenser, and measure the capacity between them. The results of tests on specially prepared bales are compared with their known moisture content, and an appendix gives an account of the radio circuits thus far employed in the investigation. The present account will be followed by a more critical analysis of the resistance and capacitance relations.

142. VARIATION IN THE MOISTURE CONTENT OF BALED INDIAN COTTON WITH ATMOSPHERIC HUMIDITY. By N. Ahmad. (*Tech. Bull.*, Series A, No. 23, 1933, Ind. Cent. Cott. Comm.) Describes the methods and results of an investigation undertaken to test the variation in the weight and the moisture content of fully pressed bales of three different types of Indian cotton—viz., Broach, Berar, and Bengals—stored for over a year in a godown under ordinary atmospheric conditions prevailing in Bombay.

143. FIBRES: PRODUCTION AND TRADE. Empire Marketing Board. (*Pamphlet E.M.B./C/6*, 1933. Abstr. from *Summ. of Curr. Lit.*, xiii., **18**, 1933, p. 480.) A collection of tabulated and annotated statistics of quantities and values of production, imports, and exports of cotton, wool, silk, hemp, flax, and jute.

144. COTTON BALES: SAMPLING FOR REGAIN TEST. By C. Levi. (*Boll. R. Staz. Sper. Ind. Carta e Fibre Tess. Veg.*, ii., 1932, p. 163. Abstr. from *J. of Text. Inst.*, xxiv., **9**, 1933, A469.) Methods of sampling cotton bales for moisture determinations are critically discussed and the sampling apparatus designed by the author and Tobler is described. A comparison is made between samples withdrawn by means of this apparatus and by careful hand sampling. A difference in moisture content of 0·1 to 0·3 per cent. has been observed between the two sets of samples. The mean length of the machine-extracted samples is slightly less than that of the hand-extracted samples, but the amount of cut fibre due to the machine is found to be negligible when considered in relation to the total weight submitted for sampling.

145. COTTON FABRICS: EFFECT OF SUNLIGHT ON. By Mary A. Grimes. (*Texas Agr. Exp. Sta. Bull.*, No. 474, 1933. Abstr. from *Summ. of Curr. Lit.*, xiii., **16**, 1933, p. 426.) Twenty-two common white and coloured cotton fabrics were exposed to sunlight to determine the effect of exposure upon the strength and colour. The average loss in breaking load of the fabrics after 375 hours' exposure varied from 8 to 47 per cent. in the warp and from 18 to 58 per cent. in the weft. Increase in hours of exposure resulted in a higher copper number, but the increase was not constant. All fabrics, whether white or dyed, underwent some change in colour. It is concluded that to lose the least strength on exposure to sunlight a cotton fabric should be composed of unbleached, mercerized, coarse, hard, twisted yarns.

146. THE ECONOMICS OF HIGH DRAFTING IN COTTON SPINNING. (*Text. Rec.*, li., **605**, 1933, p. 28.) It is stated that the cost of spinning cotton yarns can be reduced by the adoption of high drafting, and this article stresses the necessity for spinners to consider the question from the economic aspect.

147. RAW COTTON: OIL SPRAYING. (*Cotton*, U.S., 97, **7**, 1933, p. 61. Abstr. from *Summ. of Curr. Lit.*, xiii, **19**, 1933, p. 485.) Answers to a questionnaire on the value of oil spraying on raw cotton from $\frac{7}{8}$ to $1\frac{1}{8}$ inches staple are quoted from several American mills. The general opinion is that oil spraying is well worth while, especially for shorter staples. There is less dust in the card-room, the cotton works better, and a smoother and more even thread results. Cotton sprayed with oil does not shed more in the weaving.

148. A NEW TYPE OF COTTON SORTER. By E. H. Pressley. (*J. Amer. Soc. Agron.*, xxv., **2**, 1933, p. 89. Abstr. from *Exp. Sta. Rec.*, 69, **2**, 1933, p. 286.) A new device upon which combed samples of unginned cotton may be sorted, developed at the University of Arizona, is described and illustrated, with remarks on preparation of samples for sorting, some of the results obtained with the sorter, and its advantages.

149. TEXTILES: INDUSTRIAL USES. By R. H. Pickard. (*J. Soc. Chem. Ind.*, **52**, 1933. Abstr. from *J. of Text. Inst.*, xxiv., **9** 1933, A471.) The presidential address delivered at the annual general meeting of the Society of Chemical Industry at Newcastle on July 10 to 14, and indicating the possibility of utilizing knowledge of the structure and properties of fibres to the more perfect design of fabrics for special industrial purposes.

150. THE SCIENCE OF MILL MANAGEMENT. By F. Gartside. (*Text. Rec.*, li., **607**, 1933, p. 25.) The author states that "the highest efficiency in modern competitive business is not attained by centralized authority but by personal efforts in co-operative teamwork."

151. TEXTILE MILL MANAGEMENT. (*Text. Weekly*, xii., **291**, 1933, p. 115.) States the qualifications essential to efficiency.

152. BAUMWOLLEGEWEBE UND GARDINENSTOFFE. By W. Spitschka and O. Schrey. (Pubd. by Julius Springer, Berlin. Abstr. from *J. of Text. Inst.*, xxiv., **10**, 1933, P274.) The book is divided into three parts; the first dealing with cotton cloths, the second with curtain and lace fabrics, and the third with a collection of cloths samples, 96 in number, illustrating the different types of fabrics described in the first part.

153. COTTONSEED OIL: STABILITY TEST. By H. D. Royce. (*Ind. Eng. Chem.*, Anal. Ed., **5**, 1933, p. 244. Abstr. from *Summ. of Curr. Lit.*, xiii., **20**, 1933, p. 522.) An apparatus for determining fat or oil stability for the Methylene Blue-light reaction is described.

LEGISLATION.

154. AUSTRALIA. *Cotton Industries Bounty Act*, 1930-32. *Statutory Rules*, 1932, No. 58 of June 22, 1932, provides for the entry of authorized persons into factories for the purpose of taking stock of raw cotton or cotton yarn.

155. CYPRUS. *Duty-free Admission of Certain Raw Cotton.* (*Cotton*, M/c., 13/5/33.) The Board of Trade have received a copy of an Order in Council (No. 1526), effective as from March 24, which provides that raw cotton not exceeding a total of 40,000 okes may be imported into Cyprus on or before August 31, 1933, free of Customs Duty by any owner of a factory, for the manufacture of cotton yarn.

156. SOUTHERN RHODESIA. (Abstr. from *Rev. App. Mycol.*, xii., **7**, 1933, p. 463.) *Government Notice* No. 462 of August 5, 1932, provides that cotton seed may only be imported under special justifying circumstances, and permits will be limited to 4 oz. of each variety. Provision is also made for the inspection and treatment, if necessary, of all plant imports (including seed) on arrival in the country, and for the destruction without compensation of any deemed dangerous.

157. TANGANYIKA TERRITORY. *The Cotton (Amendment) Rules*, 1933. *Government Notice* No. 788 (June 16, 1933) amends certain rules and states the new rules added to the Cotton Rules, 1931.

Cotton (Fees) Rules, 1933. *Government Notice* No. 79 (June 16, 1933) states the fees payable for the year ended March 31, 1934.

158. UGANDA. *The Cotton (Amendment No. 2) Ordinance*, 1933. A Bill to amend the Cotton Ordinance, 1926, and to enable the Governor to declare raw cotton zones within which all raw cotton grown shall, subject to any special exemptions, be ginned and baled.

159. WEST INDIES: ANTIGUA. (*West Ind. Comm. Circ.*, 6/7/33, p. 279.) An Ordinance has been passed imposing a levy, not exceeding one halfpenny per pound, upon cotton exported from the Presidency, for the purpose of furthering the interests of the cotton industry. Import duties have been increased, the surtax having been increased from 10 to 20 per cent. on nearly all imports.

TRADE, CO-OPERATION, ETC.

160. LANCASHIRE COTTON INDUSTRY: REORGANIZATION. By J. Summerscales. (*Text. Mercury*, **89**, 1933, p. 91. Abstr. from *Summ. of Curr. Lit.*, xiii., **18**, 1933, p. 480.) Some details are given of a proposed scheme for applying a large public loan to the extension of ring spinning, high drafting, high speed winding and warping, and automatic weaving in Lancashire. Figures as to savings in costs of production are quoted.

161. THE WORLD TEXTILE INDUSTRY ON THE UPGRADE. By Dr. A. Niemeyer. (*Text. Rec.*, li., **607**, 1933, p. 23). Discusses the position in Great Britain, France, Belgium, Italy, Switzerland, Austria, Poland, United States, and Japan.

162. THE OVERCOMING OF THE WORLD CRISIS: NATIONAL ECONOMIC ACTIVITY. By Dr. A. Niemeyer. (*Text. Rec.*, li., **608**, 1933, p. 21.) The author writes: "The signs are slowly but surely increasing, indicating that world economy has passed through the valley of the crisis. The extent of the economic activity of the majority of countries is still far removed from that of 1928; nevertheless, since last year the total value of production, as well as the degree of utilization of productive plant, has perceptibly increased."

163. SILVER AND THE COTTON TRADE. By E. M. Gull. (*Text. Weekly*, 20/10/33.) Discusses the effect of the fall in the value of silver in Eastern markets.

MISCELLANEOUS.

164. THE INTERNATIONAL COTTON CONGRESS, 1933. (*Int. Cott. Bull.*, xi., **44**, 1933, p. 432.) At the Sixteenth International Cotton Congress, held in Prague in June last, the delegates were officially welcomed by the President of the Congress, Mr. R. Morawetz of Czecho-Slovakia.

Responding to the official welcome, Mr. Paul Schlumberger, President of the International Cotton Federation, spoke on the activities of the Federation since the previous Congress held in Paris two years ago.

The first day's proceedings were concerned with the following matters: Moisture in American cotton; moisture in Egyptian cotton; new Egyptian cotton varieties; Egyptian cotton and the tyre industry; the effects of the artificial silk industry on the Egyptian cotton industry; the cotton policy of the Egyptian Government; cotton bagging for cotton bales.

The cotton industry and the world crisis formed the main subject of discussion on the second day.

The concluding session of the Congress was held in the Kursaal, Carlsbad, under the presidency of Baron Theodor Liebig, and was occupied in passing the various resolutions drafted as the result of discussion at the previous meetings.

Many valuable papers prepared for the Congress, and dealing with such subjects as the causes of the depression in the industry, the effects of Futures

trading on the cotton and cotton yarn markets, trade restrictions, moisture in cotton, cotton bagging in place of jute, are included in the *Int. Cott. Bull.*, vol. xi., July-August, 1933.

165. DIE TEXTILMIKROSKOPISCHEN UNTERSUCHUNGEN IN DER PRAXIS. By J. Klinger. (Sallmayersche Buchhanglung, Wien, 1934.) This is a work which should prove of considerable use in the microscopic examination of materials. The first part of the book describes what has to be investigated and determined in chapters on longitudinal and transverse sections, use of polarized light, photography, etc.; the second part contains descriptions, with illustrations, of the apparatus used, while the book concludes with 80 useful micro-photographs showing the appearance of different sections of various textiles under different lighting arrangements. The book may be recommended to those who read German, but it would have been improved by the inclusion of an index.

166. SKINNER'S COTTON TRADE DIRECTORY OF THE WORLD, 1933-1934. (London, Manchester, Bradford, Montreal, New York.) This is the eleventh edition of this standard work of reference of the world's cotton industry. The customary revision of details, in collaboration with the leading Textile Associations throughout the world, has been carried through, and valuable additions have been made to the particulars previously published. A new feature is the inclusion of the Knit Goods Manufacturers, and this will undoubtedly be welcomed and prove advantageous to the numerous users of the directory. The thumb-holes for easy reference are labelled: Contents; Index; Exporters, Merchants; Spinners, Manufacturers, and Doublers; Directors (British); Finishers, etc.; Fabrics; Silk and Rayon; Knit Goods Manufacturers; Mill Supplies. All headings, indices, and explanatory notes are, as usual, printed in English, French, German, Italian, Spanish, and Portuguese. Every effort is made to ensure that all the details given are as up to date as possible, but where information is received too late to be classified in the directory, it will be found, from week to week, in the columns of the *Textile Weekly*, a companion publication. The directory is quite indispensable to all those connected with the cotton industry. The price by post, inland and abroad, is 20s.; Canada and the United States, $7 (post and duty free).

ADDENDA.

167. SUDAN. *Cotton Cultivation*, 1932-33 (*Ann. Rpt. of Secy. for Econ. Developmt. and Stats. of For. Trade*, 1932-33, recently received.) Owing to the heavy rainfall experienced much of the acreage was late planted. Serious damage was caused by blackarm and leaf curl, and the yield was expected to be considerably below the previous season.

Rain-Grown Cotton.—The output of rain-grown cotton from the Southern Provinces has diminished in the last two seasons. In 1931-32 this was chiefly due to the reduced price obtainable, and in 1932-33 the further decline was accounted for by the lack of grain following the severe locust attack of 1931-32. The reduction in price was more felt in the Shilluk country of Upper Nile Province than elsewhere, but it is noteworthy that in the hungry period the cotton-growing districts were the only Shilluk areas which did not require famine relief. In Mongalla Province the urgent need of food crops led to a reduction in the area under cotton, and blackarm disease following heavy rains reduced the yield. Granaries having been replenished, it is anticipated that there will be a considerable increase in cotton cultivation in the 1933-34 season, which, lacking the impetus of the high prices of the previous seasons, will be a development on a sounder basis.

Demonstration farms, particularly those at Kadugli and Talodi, together with a newly-opened farm at Dilling, continue to do valuable work in testing varieties of cotton, in cultural experiments and demonstrations, and in propagating seed of improved strains for issue to cultivators.

168. *Report of the Gezira Agricultural Research Service*, 1932. This is the first volume of reports issued by the Gezira Agricultural Research Service since its inception in April, 1931, and contains, in addition to the introductory note by the Controller, reports on the experimental work carried out during the 1931-32 season by the Agricultural, Plant Observation, Plant Physiology, Chemical, Entomological, Botanical, Plant Pathology, and Plant Breeding Sections.

From the note of the Controller we learn that the excellent crop obtained during the season was due partly to favourable weather conditions and partly to the fact that there was a very great diminution in the injury caused by blackarm and leaf curl. It is believed that the relatively late appearance of blackarm (first actually recorded on September 17) was definitely connected with the later sowing generally adopted, and with the fact that there was little primary infection, attributable to the use of "Abavit B" as a seed disinfectant. Investigations carried out on the incidence of disease on a number of "Record Areas" established in the Gezira demonstrated the very localised occurrence of early infection both of blackarm and leaf curl during the season, and their relatively slow spread to adjacent areas. It was also shown that blackarm in its early appearances occurred most frequently on the margins of fields, particularly alongside the edges of last year's cotton land.

The remarkable diminution in the severity of leaf curl is attributed to the virtual exclusion of lubia—an alternative host of the white fly which transmits the disease—and to the natural reduction in the amount of ratoon cotton as a result of the very dry "dead" season. Interesting experimental results have been obtained in the transmission of leaf curl to alternative hosts and in the establishment of periods during which transmission in cotton takes place most readily.

Much progress has been made in connection with the production of cottons for the Gezira which are highly resistant to leaf curl, and it is confidently expected that one strain known as "X1530"—a selection from Sakel—will be suitable for cultivation on a large scale at an early date. Satisfactory progress has also been made towards the evolution of types of American cotton suitable for the rain areas.

Considerable importance is attached to the progress made in differentiating the soils of the Gezira into areas requiring different water treatment, and in the study of the physical conditions of the soil. A preliminary study has been made of the activity of the soil micro-organisms.

Excellent results were obtained during the year from the application of simsim cake to the land as a nitrogenous manure for cotton.

ERRATUM.

"Ten Years" (Oct. issue, p. 255, para. 2, last line). The increase in production since the inception of the Corporation (1921-22) is about *300* per cent., not *400* as printed.

PERSONAL NOTES

APPOINTMENTS.

Mr. R. A. Silow has been appointed by the Corporation as Assistant Geneticist at the Cotton Research Station, Trinidad, in succession to Mr. J. B. Hutchinson, who resigned on taking up an appointment as Botanist and Geneticist at the Institute of Plant Industry, Indore.

OFFICERS ON LEAVE.

When an officer of a colonial Department of Agriculture (or of the allied departments of Irrigation, Transport, etc.) comes "home" on leave, he usually brings with him much information that may be of considerable value to similar officers in other colonies, or to the officers of the Empire Cotton Growing Corporation, who have to collect, collate, and use all possible information relating to cotton. The Corporation would consequently much appreciate the courtesy if Directors of Agriculture and others would be so kind as to inform them, in advance if possible, of the names, probable addresses, and approximate dates of arrival in England of officers coming on leave. This would give the Corporation the opportunity of getting into touch with these officers themselves, and of giving the latter the opportunity of meeting with one another. A further courtesy would be conferred if the officers themselves, upon arrival, would call at, or inform, the offices of the Empire Cotton Growing Corporation, which are at the corner of Millbank and Wood Street (entrance by the first door in Wood Street), immediately opposite the offices of the Crown Agents for the Colonies.

At the date of writing, the following officers are on leave or will shortly be arriving in England from cotton-growing countries:

British Guiana	Mr. J. D. Gillespie.
Gambia	Mr. J. W. Sparrow.
Gold Coast	Mr. J. L. Scott.
Kenya Colony	Mr. M. H. Grieve.
,, ,,	Mr. J. McDonald.
Nigeria	Mr. D. W. H. Baker.
Tanganyika Territory	Mr. W. C. Clarke.
,, ,,	Mr. J. R. Curry.
,, ,,	Mr. H. M. Lloyd.
,, ,,	Mr. D. Thornton.
,, ,,	Mr. A. J. Wakefield.
Uganda	Mr. D. S. Davies.
,,	Mr. A. B. Killick.
,,	Mr. A. H. Ritchie.
West Indies: Trinidad	Mr. R. O. Williams.

The following officer of the Corporation's staff abroad is on leave in this country:

Nyasaland	Mr. W. L. Miller.

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MIXED FARMING AND PEASANT HOLDINGS IN TANGANYIKA TERRITORY

BY

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THE PROBLEM OF OVERSTOCKING.

EXCEPT in one or two isolated instances, cattle do not occupy any recognized place in native agriculture in Tanganyika Territory. They take no part in crop production; in fact, animal husbandry in its true sense is almost non-existent.

Cattle are merely a form of wealth to the native, and too often is this hoarded in a manner most detrimental to the land and uneconomical to the Territory as a whole. Moreover, the production of cash crops such as coffee, groundnuts and cotton leads to more natives becoming cattle-owners and so inevitable "misers," as their wealth, in the true sense, is non-productive.

The problem of overstocking is accentuated by the fact that science and quarantine organization have made such headway against disease that the increase in the stock population has long outstripped the natives' capacity to manage both it and the soil at the same time. Stock have long been the backbone of British farming; stock in Tanganyika are fast rendering many areas incapable of being farmed at all; and it can be said that until the native adopts better methods of animal husbandry, tsetse fly may be something of a blessing for the future welfare of the tribes. Briefly, tsetse could be regarded as the trustee for future generations until the pressure of circumstances forces the native peasant *to farm* his land; but the danger of sleeping-sickness to the inhabitants in certain parts of Tanganyika renders it impossible to accept this and to let things work out for themselves. The evils attendant on overstocking are so pronounced in the Central Province and parts of the Lake Province of Tanganyika, that cattle have been called a pest, and as conditions are at present this may not be an exaggerated term to apply.

Markets and Tsetse Reclamation.

For the amelioration of overstocking, the remedy which generally first comes to mind is a restriction in the numbers of the cattle population. Whilst agreeing that the extension of markets to dispose of native-owned stock is very important, it is difficult to regard this as the fundamental basis on which overstocking with its attendant evil of soil erosion can be solved permanently. A great deal of our native stock is poor scrub stuff, and it is unlikely that a market for this class of meat is likely to arise outside the confines of the Territory which will absorb a sufficient number of cattle to have any appreciable effect.

In fact, it will require a large extension of overseas markets, and an increase in local consumption as well, to keep pace with the annual increase in the stock population. Supposing that the first point does occur, and concurrently that the internal consumption of meat is greatly increased by a more intensive production of cash crops (to give the means of purchasing meat to many natives who cannot now afford this luxury), the position will still be precarious, for it is at the mercy of world prices, which have proved fickle before now, and will do so again.

Then there is the extent to which tsetse reclamation can assist. The importance of this work is also great, but, taken alone, it no more provides the fundamental basis on which overstocking can be overcome than does marketing under the present wasteful conditions of a pseudo kind of ranching and the annual bush-burning. It probably takes about 15 acres to maintain a beast, so that to give accommodation to 1,000 head of cattle 15,000 acres must be cleared of tsetse, and there are some five million head of cattle occupying land fitted to carry possibly less than four million under existing conditions.

Going further, supposing that there is sufficient grazing to maintain the present cattle population, and that markets are available for the disposal of surplus stock, the questions to be answered are: Is the fertility of the land being maintained; has the native advanced in his methods of caring for both his stock and his land, and so made the position more secure for future generations; and if markets fail, as, unfortunately, they have a habit of doing, what will be the position? An attempted solution based on marketing and tsetse reclamation alone will most likely lead to a recrudescence of the problem, although these measures must help to a certain degree.

The crux of the whole matter is that cattle are not regarded as

soil fertilizers. With some tribes near Dodoma the size of the dung-heap which lies permanently outside the cattle-owner's hut is taken as the measure of the owner's importance amongst his fellow-men; never is the manure returned to the soil. On the shores of Lake Nyasa and over the plateau of the Central Province, cattle manure is burnt, in the first instance to provide salt for domestic use, and often elsewhere for fuel. Until the agricultural value of the use of farmyard manure is realized by the native, very little can be achieved; the realization of this is almost more important than the practice of rotation of crops.

The key to the solution of the overstocking problem must be mixed farming (entailing the making and use of farmyard manure as has been done in Great Britain for many years), closely co-ordinated with the important work of tsetse reclamation and with marketing. The first of the two minor remedies will inevitably go hand in hand with the normal increase in the human population; the last depends not only on the world markets but also on raising the standard of living of the native inhabitants of the whole territory, and this can only be achieved by the production of economic crops.

Improvement of Ranching Conditions.

Before proceeding to a more detailed description of mixed farming, it will not be out of place to review the possibilities of making better use of the existing grazing, for the introduction of mixed farming into the rural economy of the African peasant is bound to be a slow process, and no act of amelioration, however small in itself, should be scorned in treating the serious problems of overstocking and soil erosion.

In many cattle-raising countries, ranchers have improved their prairie lands by fencing and by the introduction of alfalfa pastures. Anything but live fences (which should be encouraged on every possible occasion, for these in themselves prove most effective in preventing soil erosion) is out of the question for the greater part of native Africa. For some time the Veterinary Department has given attention to an examination of the indigenous pasture plants and to the introduction of exotic grasses. But, apart from all this, there is no doubt whatsoever that a great deal can be done by conserving the cattle feed which is available today, and much of which is wasted by burning. After the bush-firing period, the cattle

are restricted to areas near watercourses and valleys, and erosion becomes extremely severe.

The cutting, making and stacking of hay by cattle-owners would go far to enable the stock to be carried through the dry season without destroying the more favoured watered areas. It is all a matter of organization and the training of oxen to use a simple form of hay-drag. It is difficult to imagine the nomadic Masai tribe going further than this, while to those tribes amenable to mixed farming, hay-making ought to be an essential part of the system of mixed farming.

In the Mbulu District of the Northern Province, the Native Authorities have for long made pasture reservations to carry the cattle over the dry season, and these are strictly enforced by their own tribal laws—an indication that they are not unaware of the problems of overstocking and not averse to applying the means of combating them.

Mixed Farming.

In parts of the Lake, Western and Central Provinces, mixed farming is bound to take its place in time; its introduction will sometimes be preceded by tsetse reclamation. Often the population is meagre and scattered, and here the first principle to be followed is that of concentration of the inhabitants in selected areas well favoured as to soil and water, as in fact is now being carried out in the Western Province and parts of the Lake Province. Until this is achieved, many schemes of tsetse reclamation must fail, others will be costly to carry out and difficult to supervise. If concentrations of population in cleared areas are not of sufficient density and extent, the bush will reappear and tsetse will again creep in.

Where a dense population has existed for some considerable time, and crops are constantly taken from the same land without any manuring whatsoever, the soil will become worked out, and either a movement of the people concerned will be necessary for their continued existence, or soil fertilization must become an essential routine. Actually this soil impoverishment and land hunger is seen near Lake Victoria, and it is here that mixed farming will come into its own more quickly than elsewhere, while even now, in their desire for a more productive soil, people are moving into and clearing the fringes of tsetse areas.

In the past, unsettled years of slave raiding and tribal warfare have not admitted any tradition of good farming; a well-filled granary,

an imposing house, and other results of consistent and careful toil would be a danger to the native peasant. His tradition has sensibly been one of hand-to-mouth existence, but it has produced an improvident and what is often regarded as a lazy cultivator. This is probably the greatest obstacle to the introduction of mixed farming, which gives a better distribution of labour over the year, and, through the plough, will not demand the arduous labour of the hand-hoe.

An average native family tills with the hand-hoe from 2 to 3½ acres of land per annum. A family with two trained oxen should be capable of keeping from 9 to 12 acres under constant cultivation. Under the present primitive methods little or no stumping is necessary, and so there is a tendency towards a shifting cultivation, wasteful of land and effort, and accelerating soil erosion in extent and intensity.

Under the more efficient method of ploughing, the 10 acres or so rendered within the capacity of a native family will of necessity have to be stumped, and having carried out this work, the native farmer will be loath to shift his cultivation, which would mean sacrificing the work he has done, in order to clear and stump a further 10 acres. But he cannot keep on cropping his land indefinitely unless he manures the soil and maintains its fertility. Thus he is forced to a better standard of farming, which must, however, be taught him patiently and consistently.

The introduction of ploughs into native agriculture is bound to be a slow process; measures undertaken to bring about any spectacular distribution of ploughs are more likely to fail than succeed, as they have done, and so in the end prove a serious obstacle to the aim in view. Also experience has shown that the provision of costly heavy ploughs for the first breaking up of virgin land has merely placed a mill-stone round the neck of the unfortunate purchaser; neither does co-operative or communal ownership of such expensive implements work out at all satisfactorily. There is also a tendency to regard the success of ploughing schemes as dependent on the price of some economic crop such as cotton or groundnuts; ploughing requires a sounder basis than commodity prices if it is to find its place and persist in native agriculture; to think solely of crop prices in connection with ploughing is weak, and when prices are good will lead to soil poverty and more erosion.

The projected 10 acres for mixed farming must be gradually stumped and broken up by hand, taking 2 or 3 acres each year, and the hoe—a heavy one, however—should take the place of the heavy plough. As the soil is worked and manured its tilth will

improve, and ploughing becomes easier, and is possible even with a simple wooden plough. Primitive wooden ploughs are regarded as a stepping-stone to the use of a more effective iron implement. The former are being made locally in the Maswa District of the Lake Province at a cost of five shillings only, and together with the Indeybo and Mysore iron ploughs are in constant use by the pupils of the Shanwa village school under the close supervision of an Agricultural Officer who is especially keen on animal husbandry and mixed farming.

The practical interest displayed in ploughing by the peasant cotton growers in the vicinity of this little village school shows the vital importance of having the right man—a man who thoroughly understands cattle—in the right place.

Ploughing with implements well within the scope of the native is also carried out at the Ukiruguru Seed Farm, Mwanza, and the Lubaga Agricultural Station, Shinyanga, providing information and experience to the Agricultural Officers as well as demonstrations to the native cultivators, which will be of the greatest value in extension work, for they will be talking about and demonstrating facts, and not hopeful fancies.

Before passing to the means whereby a peasant farmer can crop continuously and yet maintain 10 acres in good heart, the point should be made that, at the time of ploughing and sowing, man and beast under present conditions are generally at their lowest pitch; food stores are getting low towards the end of the dry season, and most of the oxen have to wander many miles per day to pick up here and there what is too often merely indigestible fibrous cellulose, and in the majority of cases the animal must use up more energy in seeking for, masticating and digesting its food, than it obtains from it. Man and beast should be especially well fed at this time, and food storage methods for both need improvement.

It is customary in the Maswa District for the natives to walk amongst the untethered kraaled cattle before they are turned out to graze, and to obtain sufficient milk for their needs by holding the milking vessel in one hand and drawing the milk with the other. This practice is to be deprecated, for only those cows which are quiet and tractable are milked regularly and heavily, their calves consequently becoming starved and developing into but poor specimens both for breeding and working purposes. On the other hand, the wild intractable animals are never milked, and their calves thrive and become good breeding animals but poor workers. Thus carried to extreme this one-handed milking is developing a wild type of

cattle of little use to mixed farming, and one of the most important practical lessons given to the pupils of the Shanwa school in the Maswa District is to tie up the cattle of the school herd, especially the wilder ones, and to milk with two hands.

The adoption of mixed farming will mean that the native must become reconciled to the steady call for work which is entailed in mixed farming. At present he is, or more often his wives are, overworked at seed time and harvest, whilst the remainder of the year is spent in comparative idleness.

The increase in production which would follow the use of the plough would necessitate some better form of transport than the head load; for short journeys the two-wheeled Zanzibar cart is ideal, and this type is now in use as a demonstration at Lubaga and Ukiruguru, Lake Province, and at Morogoro and Moshi.

Farmyard Manure.

On many cereal-growing farms in Britain, cattle are kept as much for the farmyard manure they produce, as for the sale of beef; yet in Tanganyika farmyard manure is rarely applied to the land and cattle are often regarded as a pest, and they will continue in disrepute until proper use is made of them in mixed farming. Rather than be a serious drain on the fertility of the land, every individual of the cattle population should be a means of increasing soil fertility by a proper utilization of properly made farmyard manure. The dried and desiccated boma or kraal manure obtained from the open enclosures where cattle are penned in at night is not farmyard manure and is often worse than useless, for the soluble nutrient salts are mostly washed out, and before the fibrous residue can be made available in the soil for the use of plant life, nitrogen may be taken from the soil by the bacteria which break down the fibrous material; crop residues such as straw, dead leaves and trash are similarly of little use to the plant, and if incorporated in the soil, the latter becomes overburdened in its attempt to supply nitrogen to both the growing crops and the bacteria which act on the fibrous crop residues.

An increase in crop yields of 10 per cent. is as much as can be expected in practice by improving seed-strains, whereas an increase of up to 100 per cent. may be expected by the application of farmyard manure. Moreover, such heavy dressings of farmyard manure as are given in England are not necessary under tropical conditions.

Before cattle can take the desired place in native agriculture, ranching and pseudo-ranching methods must be restricted; dairy cows for the making of ghee and the provision of milk for the children should be stall fed as far as possible, as well as a certain number of cattle destined for the butcher (stalls need not be at all elaborate). Crops must be grown for this purpose, guinea grass, napier fodder, teff grass, edible canna, kudzu vine, certain sorghums, maize, sweet potatoes, pumpkins, and in highland areas cabbages, lucerne and root-crops can be worked into rotations. Crop debris of sorghums, maize and groundnuts can also be used as fodder. Velvet and bonavist beans can be grown in standing maize without interfering with the corn yield. (As a soil renovator in Southern Rhodesia velvet bean is regarded in the same way as the clover in England.)

The cattle must be bedded, and the work oxen are best housed at night in the manure-shed, which consists of poled walls and a grass roof. The manure and bedding from the dairy cattle is carried each day and placed in this shed to be trampled and added to by the oxen at night. It has been found at the Morogoro Experimental Station that there is no trouble from flies if a light sprinkling of grass or straw is spread daily over the heap.

It is again stressed that the plough oxen must be well-fed, especially before and during the working season, a time when they are usually starved.

In addition to the plough and the cart, the use of such simple implements as the sledge, the hay-drag and dam-scoop should also be demonstrated.

Rotations.

One of the chief causes of shifting cultivation and low yields is the absence of crop rotations. Different plant species have different food requirements and different mechanical effects on the soil. If one species is grown year after year in the same soil, that land may become deficient in one or more of its plant food elements; also with grain crops, the continual shallow cultivation by means of the hand-hoe often results in the formation of a "cultivation pan," a frequent cause of low yields and of plants which are easily droughted; such pans also increase sheet erosion. They are best and most cheaply broken up by sowing a crop of pigeon peas every five years or so; the inclusion of cotton in a rotation will go far to avoid them. Again, the crop residues of sorghums, especially of the sweet kind, contain

highly oxidizable material which, if turned into the soil, retards the normal biological activities of the soil and succeeding crops become starved; such crop residues therefore should be fed to cattle and not turned in. With maize the danger of digging in the trash lies in the spread of disease. Such parasitic plants as *Striga* render rotations imperative in some areas; ox-drawn cultivators for cleanly farming also help to keep down this pest.

It should be obvious that no system of mixed farming can be carried out except on a rotation in which cereals, pulse, and economic or cash crops all play their part. It is a mistaken and harmful conception that cash crops can only be attained at the expense of food crops; there is no doubt that the one is helpful in every way to the other, and in the type of mixed farming which is visualized in Tanganyika, the production of root crops for cattle food is in itself an anti-famine measure.

PEASANT HOLDINGS.

The disappearance of shifting cultivations which will follow the adoption of mixed farming will tend to develop what is called the peasant holding. Every incentive with mixed farming will naturally be for the cultivator to become more closely identified with one piece of land: he will not want to move from it; its fertility will be his care; the welfare of his stock will become his pride; at least a portion of his greater income from the land will be returned to the soil that produced his wealth; permanent fruit trees will be planted, the food supply of the household should be more wholesome and more certain. Housing conditions will also improve, for the peasant farmer will come to know that there will be no need for him to shift his cultivations, so that he can dig the foundations of his house more deeply and more surely than heretofore.

A peasant holding might well consist of the dwelling house, with a single cow-byre and a shelter (which also acts as the manure shed) for the oxen nearby, and with an Indeybo plough, a wooden stirring plough, a ridger, a Zanzibar cart and hay-drag as essential implements. The native farmer would gradually accumulate these. His first need would be to concentrate on the food supply for the requirements of his family and his cattle, and within three or four years the 10 acres should be under a prearranged rotation. A small orchard of suitable fruit trees would be provided from planting material supplied from the Native Authority Seed-farms. The whole 10 acres would be

best enclosed by a live hedge (there must be many indigenous bush plants which would do). It must be remembered that the hedges of England exist only through constant attention, and the same care is necessary under African conditions. Fodder trees could be planted for shade and cattle-food in the nearby grazing lands, and where necessary shelter belts should be provided.

This all seems so idealistic as to be unattainable, but what one tribe has done, another can at least attempt, and one is encouraged by the examples of the systems followed on Ukara Island in Lake Victoria Nyanza, and on Mount Kilimanjaro by the Wachaggu.

The density of the population on Ukara Island is something like 600 per square mile; the inhabitants are not outstanding in intelligence or physique, yet they have the best and most intensive system of farming throughout Tanganyika Territory—they have been forced to it by the pressure of population. At least three crops are taken off the same land in two years; the land is continuously cropped, yet is still fertile and productive. The secret of this is the stall-feeding of their cattle and the fertilization of their soil both by green manuring (*Crotalarias* and *Tephrosias* are actually grown by them as pure crops for green manuring) and the application of well-made and carefully preserved farmyard manure. Their cattle are even muzzled whenever they are taken from their stalls to water, so that they will not damage the standing crops. Many of the indigenous trees are used as fodder, but care is taken to strip the leaves and twigs in such a manner that the trees are not destroyed or harmed; pits are dug in the Lake shore near to its water's edge, and in this a species of grass is grown for cutting and stall-feeding green to the cattle. All crop residues are carefully collected and stacked either on rocks or in the framework of a tree's branches, in order to protect them from the white ants which abound in the soil, yet which do not destroy the moist well-rotted farmyard manure which is incorporated in the soil (white ants soon remove all traces of the dried and desiccated boma or kraal manure). The cattle always look well-fed and well-cared-for; and so they must be, for without them a large proportion of the island's population would have to emigrate.

In regard to the more intelligent Wachagga coffee growers of Kilimanjaro, the following is extracted from the annual report for 1931 of the Department of Agriculture:

"The subject of maintaining the fertility of the soils of Kilimanjaro cannot be dismissed without reference to the 'soiling-system' of feeding cattle, that is by growing rotations of such green crops as lucerne, maize, peas and oats, cabbages, etc., to be cut and fed green

FIG. 1.—STALKS OF PENNISETUM STACKED ON ROCK AS PROTECTION FROM WHITE ANTS: UKARA ISLAND.

FIG. 2.—FODDER TREE (*Ficus sp.*) ON UKARA ISLAND, WITH STACK OF MILLET STALKS BUILT IN ITS BRANCHES TO PROTECT FROM WHITE ANTS.

FIG. 3.—A GREEN MANURE CROP OF CROTALARIA STRIATA IN THE BACKGROUND, AND FARMYARD MANURE APPLIED TO THE LAND IN THE FOREGROUND: UKARA ISLAND.

FIG. 4.—PIT DUG CLOSE TO THE LAKE SHORE AND PLANTED WITH GRASS (*Sw. Masimbiri*) FOR STALL-FEEDING TO CATTLE: UKARA ISLAND.

FIG. 5.—LOCALLY MADE WOODEN PLOUGH; COST 5S.: SHANWA DISTRICT, LAKE PROVINCE.

FIG. 6.—A RIDGER PLOUGH WORKED BY ONE MAN AND TWO OXEN, NO REINS: SHANWA DISTRICT, LAKE PROVINCE.

(Figs. 1-4 by courtesy of Mr. D. Thornton, D.A.O. Musoma. Figs 5 and 6 by courtesy of Mr. B. Hartley, D.A.O. Maswa.)

to the cattle which are kept indoors the whole time, except for one or two hours for daily exercise in an open enclosure; the manure being returned to the soil each day, and after the second or third cutting of such leguminous crops as lucerne, these are dug in for additional improvement of the soil. This is an intensive system of dairying, for which the Northern Province is well suited. It is followed by the native (of Kilimanjaro) at the present day, but, instead of growing cattle-food, their womenfolk laboriously cut and carry over a distance of several miles, grass from the plains. Edible canna is capable of giving high yields of green leaves and succulent roots during the dry season, and this crop has been introduced as a stock feed into native agriculture, in the hope that its extended use will save the present waste of labour in grass-cutting and carrying."

The Introduction of Mixed Farming into Native Agriculture.

In deciding the means of leading the native to adopt a system of mixed farming, it must be realized that progress will be slow—in fact, it may almost amount to a process of evolution, and may take more than one generation before the system is adopted to any appreciable extent. But this should not prevent a start being made, however modest this may be. It must be remembered that we ourselves have still much to learn regarding animal husbandry in the tropics. A good deal of knowledge has already been gained, however, at the Morogoro Experimental Station, where a dairy herd of grade cattle was installed some two years ago; at the Lubaga Experimental Station, Shinyanga, where there are ninety head of working oxen; and at the new Ukiruguru Station, where most of the field work is done by oxen. Then again, Agricultural Officers are giving the matter their earnest attention, and the progress made by the District Agricultural Officer for the Maswa District, both in the care of native cattle and the extension of ploughing into native agriculture, is preparing excellent material for future propaganda and development. In addition to the work being carried out at the Shanwa Village School, practical animal husbandry is being taught at the Nyakato Central School, Bukoba, which is now run entirely as a school of agricultural training. Tentative plans are the training of selected natives at some central farm such as Lubaga, and under the constant supervision of an Agricultural Officer who will have had the advantage of all the trials, demonstrations and results which are going on and are being achieved at experimental

stations, demonstration plots, schools and in the peasants' own fields. It is also desired to set up and foster under supervision proved native cultivators on model peasant holdings such as described above. It may be that a model peasant holding on the central farm will give the best means for training three or four native farmers, and for selecting two of these to work on their own peasant holdings, which should be near enough to receive the closest supervision possible. This would enable the difficult early period to be passed in the safest manner, until we can learn how to train a greater number of natives, possibly by apprenticing them to the central departmental or native authority farms, and finally to adopt some self-supporting scheme of setting up the trained men on peasant holdings of their own.

The more one considers the allied questions of overstocking, soil erosion, tsetse reclamation, soil impoverishment, and general agricultural and economic advancement, the more one realizes the magnitude of the task, and it is one which demands the closest co-operation between the administrative, agricultural, veterinary and educational officers; and it augurs well for whatever steps are taken that the desired team spirit is there and has shown itself time and time again in this and other problems affecting the present and future welfare of the inhabitants of Tanganyika Territory.

Received February, 1934.

COTTON IN SOUTHERN RHODESIA

BY

G. S. CAMERON,

Cotton Specialist, Southern Rhodesia.

THE thought-provoking editorial "Ten Years" in the October issue, Volume X., of the *Empire Cotton Growing Review* suggests: "A short account of the obstacles which have prevented cotton from becoming a commercial success in certain countries would prove an interesting addition to the Journal, and would be very useful in helping to indicate lines that should be followed in carrying on further work for the extension of cotton cultivation in the areas in question." The following is written with a view to clarifying the position in so far as it refers to Southern Rhodesia.

To begin with, we have to remember that the industry started only ten years ago and under the worst circumstances possible—namely, at the height of a world boom in cotton. The period immediately preceding the cotton boom had been a thin one for such a young country as Southern Rhodesia, built up in little over thirty years from a savage Native State. In that period it had experienced the Matabele War, the Native Rebellion, the Jameson Raid, the Anglo-Boer War on its southern border, and finally the period of the World War and its aftermath. The advent of the cotton boom dazzled the sorely tried farmers and appeared to indicate to them, at long last, a way out of their many difficulties. It seems to be the fashion in certain circles to blame the Rhodesian farmers for losing their heads, but if we try to recollect the world attitude to cotton at that time, it may help us to temper our judgment. Cotton was then selling at 18d. to 20d. per lb., and the first trial crop planted by the Rhodesian farmers realized these prices. The Press was stressing the world shortage of cotton, and it was then stated that if we could only get back to shilling cotton, Lancashire would recover her lost position. Small wonder that Rhodesian farmers took the plunge. The plain fact of the matter is that there was no one then in the country of sufficient standing to guide them. The first responsible Government had just come into being, and was fully occupied in taking over its responsibilities. Its attitude was one of caution, but by that time caution was too late, and even if a firm stand had been taken,

and the growing of cotton actually opposed, it would have made no difference then, though it might have added to the Government's prestige later.

From 1,500 acres the crop jumped to over 62,000, but the yield per acre dropped from 428 lb. of seed cotton per acre to 93 lb. This reverse might have had a damping effect on the enthusiasm of the farmers, but not a bit of it. They attributed their low yields per acre to the exceptionally wet season which had been experienced, and the following year planted an even greater acreage. This crop, from a yield-per-acre point of view, was little better than its predecessor, and prices dropped to such an extent that most cotton crops were grown at a loss. By this time it was realized that the type of cotton grown was not suited to the country, and another two or three years would have seen the end of the cotton-growing industry as far as Southern Rhodesia was concerned, were it not for the combined policy of the Government and the Empire Cotton Growing Corporation. The former was fully alive to the advantages which would accrue to the country if a successful cotton-growing industry could be established, and the latter was prepared to continue its work in the country, especially in view of the sympathetic attitude and strong support received from the Government and many of the leading farmers in the Colony. By this time it was definitely proved that the preceding crop failures were due, in the main, to jassid, and the advent of Parnell's U.4 cotton, which is highly resistant to jassid, put an entirely different complexion on the whole outlook. It was known that bollworms and stainers would be a severe handicap, but the whole issue was obscured by the jassid problem, and this problem had to be solved before any further advance could be made.

It is necessary, at this stage, to review the attitude of the farmers towards cotton growing. They began, as has been shown, in high hopes of establishing a new and profitable industry, and persisted even against poor yields and falling prices, but continued combination of both proved too much for them. The position was admirably summed up by the then Minister of Agriculture, the Hon. R. A. Fletcher, when he stated that the farmers' attitude to cotton was one of " a reactionary spirit of disappointment." It certainly was, and who can blame them ?

For those whose duty it was to keep hammering away at the cotton problems, however, the appearance of the U.4 variety gave a fresh impetus to their endeavours. In 1927-28, on the Cotton Station at Gatooma, a small quantity of U.4 seed, between 10 and 15 lb., was multiplied up and gave about 1 ton of seed. But for

the fact that it was a year of comparatively light bollworm infestation, this remarkably good result would not have been achieved. The following year (1928-29) this ton of seed was judiciously distributed among farmers, and increased to 66 tons. The year 1927-28 may therefore be considered as the beginning of the second phase in the attempt to establish the cotton-growing industry, and if we glance at the table on page 256 of Volume X. in the Editorial "Ten Years," we can see slow but steady progress until 1931-32.

For ready reference the following figures are taken from the above-mentioned table:

1927-28	production	90 bales.
1928-29	"	280 "
1929-30	"	1,481 "
1930-31	"	1,974 "
1931-32	"	579 "

We are now in a position to add:

1932-33	production	355 bales.

The sudden drop from 1931 onwards is due to the price factor, combined in one instance with a year of late rains and consequent bad opening.

It would appear, therefore, as if the second phase, which started with promise and continued so for three years, is about to come to an inglorious close. Such, however, is not the case, and it is remarkable that, at the time of writing, an increased acreage has been planted to cotton this season, although the prices realized last year varied from 4·26d. to 5·03d. per lb., from which had to be deducted ginning, forwarding, and other charges, amounting to 1·45d. per lb. For this state of affairs the following reasons are offered. A certain number of "stalwarts" among the farmers persisted with cotton even through the period of record low prices, and evidently discovered that if they did not make a profit on the crop, at all events they did not lose financially. On the other hand, they stood to gain (1) increased crops the following year after cotton, (2) seed for feeding their stock, and (3) a certain amount of grazing on the old cotton plants at a time of year when grazing is scarce.

Even at last year's price level, certain farmers made a profit on their lint alone. This has been possible owing to their obtaining fairly good crops, averaging between 600 and 700 lb. per acre, at a low cost of production. As cotton in this country does not appear to respond to the direct application of artificial fertilizer, there is a considerable saving on this account alone, and it now appears possible to produce a cotton crop at about 15s. per acre, taking into account

only the primary costs of ploughing, harrowing, planting, thinning, cultivating, and picking. Such low production costs have left these farmers with a profit of round about £2 per acre on their cotton, plus the advantages mentioned above. This is as much as, if not more than, is made on an acre of maize, in spite of the fact that maize is artificially bolstered up by means of the Maize Control Act.

It appears as if these modest results, obtained, unfortunately, in isolated instances only, have been sufficient to induce other farmers to try and do likewise. Although the facts about cotton are only getting round slowly, they are nevertheless having an effect, and even in January (1934) enquiries have been coming for seed for next season's plantings. Now that prices have advanced (February, 1934), it is anticipated that a much greater acreage will be planted next year than was even hoped for a month ago.

It may be too much to expect farmers at the moment to be alive to the position of cotton in relation to other crops, though a few of them do realize it. Cotton is about the only crop in the country which is sold on the world's market without the aid of indirect forms of subsidy such as preferences, controls, and bounties. Tobacco enjoys a preference of over 2s. per lb. on the British market, and yet the number of prosperous tobacco farmers is not great. Maize, as previously mentioned, has a controlled price if sold locally, in order to enable the export of surplus maize, the price of which today is below cost of production. Stall-fed beef for export obtains a bounty of ¾d. per lb. Against all these, cotton obtains no preference whatsoever, because it is not yet an established industry, and perhaps it is as well that such is the case, for once it does become firmly established, as undoubtedly it will, it will have done so entirely on its own merits.

One may pertinently ask why, if the foregoing statements are correct, the Rhodesian farmers have not realized the advantages to be derived from cotton growing? The straightforward reply is that cotton has not been grown long enough, or on a large enough scale owing to the adversities previously mentioned, for the farmers to become "cotton minded." In other words, the industry has not yet become established on a large enough scale, and the memory of early failures is still fresh in the minds of many who justifiably dropped cotton in favour of other and more profitable crops.

Such a condition of affairs could no doubt be overcome by adopting a vigorous cotton campaign, but anything savouring of propaganda has been carefully avoided and for very good reasons. The increase in acreage that would be obtained from publicity methods would

increase also the number of complete or partial failures, and add further to the already existing suspicions of the less enlightened members of the farming community. It is a far better and sounder policy to let the cotton movement spread slowly by means of the more reliable farmers, who have tried it out judiciously, and who are now making a success of it. The propaganda weapon, therefore, is best held in abeyance until such time as it is really required, and it will be all the more effective because of not having been previously used, or shall we say misused ?

Another reason for the " slow " policy is that we are still in the stage of multiplying up newer and better strains of U.4, which have been bred on the Cotton Station at Gatooma. These have to be carefully tested in the various districts, under close observation, before it is advisable to release them for general cultivation. This is a slow process, which takes a long time, during which, however, much important information has been gathered concerning cultural practices, such as early planting, thinning and spacing, soils, environment and insect pests.

In the last year a new factor has been introduced into the cotton-growing industry, and that is its introduction as a native crop. This is quite one of the most promising lines of development, which might have been initiated at an earlier stage, but here again it was necessary to go slowly, as the propitious moment for launching a native cotton-growing policy had not arrived. With seed that has been carefully bred and multiplied under European supervision, we are in a stronger position to supply suitable seed to native growers. For several years it will be necessary to curb any tendency to " push " cotton growing among natives, as a false step at the beginning would retard future expansion. The majority of the densely populated Native Reserves are situated in promising cotton-growing localities, and we may reasonably feel that we are on the verge of big things in this new line of development.

Though the cotton output of Southern Rhodesia at present is undoubtedly small, it is capable of expansion as and when required; all the more so, since, as mentioned above, it has now been definitely decided to foster cotton growing among natives—a policy which may have results that will well exceed any expectations ever entertained when cultivation was limited to European growers only.

Had the false start made in 1923-24 been allowed to fizzle out, it would have taken many years to overcome the memory of that failure, and have made the reintroduction of commercial cotton growing almost an impossibility. As it is, the nucleus of an industry

has definitely been put on the map of the Empire, and there is every reason to hope that in time it will expand to such proportions as will justify all the patience exercised and time and money expended in fostering it.

It is hoped that the foregoing is an answer to the very justifiable query in the Editorial "Ten Years." It is largely a vindication of a slow but sure policy which has never tried to measure results in terms of bale production, but rather is taking every precaution to ensure that the foundations of a future industry are being well and truly laid.

[A very interesting article, which fully explains the position as far as Southern Rhodesia is concerned.—ED.]

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THE COTTON STAINER PROBLEM

BY

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The cotton stainer problem, which is one of the most serious of many difficulties facing cotton growers throughout the world, may be briefly outlined as follows.

In nearly every cotton-growing country, actual or potential, various species of a certain group of insects suck the older green bolls, the open bolls, and particularly the ripening seeds of cotton, and in the process of feeding not only cause direct injury to the boll and to the germination of the seed, but also introduce fungi and bacteria into the interior of the boll. These set up an internal rot, accompanied by discoloration, which causes a considerable loss in yield of cotton and an equally serious loss of quality in the lint which survives.

It is, perhaps, of passing interest to note that the body colour of the majority of these insects is red, and that the internal discoloration of the bolls is also red, and that the name "cotton stainers" was originally given to this group of insects under the idea that the red staining of the lint was due to the bodies of the insects crushed in the picking and ginning processes. Although we now know that this is not the true explanation, the name "cotton stainer" still remains a correct and suitable designation.

To discuss the problem in a little more detail we will take in order first the insect itself, secondly the fungi and bacteria causing the internal rot, and then return to the insect again to discuss its life-cycle, relation to climatic conditions, alternative food plants, seasonal variation in numbers, migration, natural enemies and control.

The Insects Concerned.

The "cotton stainers," which are in general red and black insects about two-thirds of an inch long in their fully grown stage, belong to the genus *Dysdercus*, which is one of the largest genera in the family Pyrrhocoridæ of the sucking bugs or Hemiptera. This genus, according to the most recent systematic catalogue, contains about seventy-five species which are all tropical or sub-tropical. Nine species are found in North America, ten in the West Indies, twenty in Central or South America, fifteen in Africa, seven in Southern Asia,

and eight in Australia and Oceania, but there are none in Europe, and none yet recorded from South Russia, Egypt, or Iraq. It will be seen that with the exceptions just mentioned the whole of the cotton-growing areas of the world are included.

More than half of these species have been recorded feeding on cotton, but probably only a dozen or so are at present of outstanding economic importance. In the United States *D. suturellus* and *D. albidiventris* have been recorded as pests, but are not of major importance on cotton. The former species has been known to cause shedding of citrus forests in Florida.

In the West Indies *D. andreæ* is the most important insect in the Northern Antilles, *D. discolor* (=*delauneyi*) in St. Vincent and *D. howardi* in Trinidad. In South America *D. ruficollis* is one of the most serious pests of cotton in Peru.

In the East, *D. cingulatus* is recorded as a pest of cotton in India, but the writer is informed by the British Museum of Natural History that there is some doubt as to the correct use of this name for the Indian species, the proper name probably being *D. melanopygus*. In Australia *D. sidæ* is recorded as a major pest, and it is undoubtedly distinct from the Indian species, although the same name has been used at times for both insects.

In Africa, where the stainer problem is perhaps more important than anywhere else in the British Empire, there are several species of major importance, the distribution of which is shown as far as possible in the following table:

DISTRIBUTION OF PRINCIPAL COTTON STAINERS IN AFRICA.

	Cardinalis.	*Fasciatus.*	*Intermedius.*	*Migratorius.*	*Nigrofasciatus.*	*Superstitiosus.*	*Hæmorrhoidalis.*	*Melanoderes.*
S. Africa ...		×××	××		×××	×		
S. Rhodesia ...		××	×××		×××			
N. Rhodesia ...		×××	××	×		×××		
Mozambique ...		×	×			×		
Nyasaland ...		××	××	×	×××			
Tanganyika ...	×	×	×××		×	×××		
Kenya	×	×		×	×××	×		
Uganda	×	××			××	××		
Somaliland ...	×	?						
Abyssinia ...	×				×	×		
Eritrea	×				×	×		
Sudan	××	×××		×	××	×××		
Fr. Equatorial Africa					×	×××	×	
Congo		×××			×××	×	×	×
Nigeria		×××		×	×	×××	××	×××
Sierra Leone ...		×		×		×		
Gambia		×						

××× = Serious pest; ×× = less serious; × = known to occur.

From this table it will be seen that three important species, *D. fasciatus*, *D. nigrofasciatus* and *D. superstitiosus*, are distributed throughout Africa; *D. intermedius* is confined to South and East Africa; *D. cardinalis* to East and North-East Africa, and *D. hæmorrhoidalis* and *D. melanoderes* to the Congo and West Africa. The species *migratorius* is widely distributed but nowhere serious; it is possible that it is not a true member of the genus *Dysdercus*. *D. scassellatis*, described from Somaliland, is probably only a form of *fasciatus*.

Although the names given above are according to the present knowledge, the separation of some species one from the other is a matter of great difficulty, even for experts. The matter is complicated by the fact that a number of species have varieties which differ slightly from the typical form. Thus in Trinidad *D. howardi* has a variety *minor* which is smaller, dark-coloured, and lays smaller eggs. It pairs with the type form, however, and is fertile with it. Several similar cases are known and as an extreme example we have, in Nigeria, two varieties of *D. superstitiosus*, called by Golding the "banded" and the "spotted" forms, which, according to this investigator, differ in markings, in time of appearance and in rate of multiplication on the cotton crop, in rate of development, and several other factors; and, further, although cross pairings are occasionally seen, they are infertile. In spite of these differences, Golding considers they are varieties and not species.

It has been suggested, but never proved or even properly investigated, that some of the varieties are similar to the "phases" recently discovered in locusts, and so may be related to the crowding of individuals before migration.

The Fungi and Bacteria.

As has been explained briefly above, the most serious damage done by the cotton stainers is the introduction into the developing boll of certain fungi and bacteria which set up internal boll rot and staining of any lint which survives.

The introduction of the bacteria appears to be largely accidental, and they are liable to enter the boll through any insect puncture or even those made artificially with sterilized needles. Between the fungi and the insects there is, however, an obligate relation in that the fungi can only enter the boll if introduced by the sucking of cotton stainers or certain other related groups of plant-sucking bugs. The relation between the fungi, cotton stainers and internal boll rot

was discovered simultaneously by Nowell and Ashby in the West Indies, and the production of the disease in this manner is now known as "Stigmatomycosis."

Four fungi have been found to be concerned:

(1) *Spermophthora gossypii*, known from cotton bolls in the West Indies and Africa, and also from fruits of *Lycopersicum esculentum* and seeds of *Vigna* sp. in the West Indies.

(2) *Eremothecium cymbalariæ*, known from cotton bolls and tomato fruits in the West Indies.

(3) *Nematospora gossypii*, known from cotton in the West Indies and Africa, and seeds of *Datura* and *Asclepias* in the West Indies.

(4) *Nematospora coryli*, known from cotton and numerous fruits belonging to about eight natural orders in the Orient, Africa, the West Indies and U.S.A. and Mexico.

These fungi, when introduced naturally by means of an infected sucking plant-bug or artificially by inoculation, set up a rapid rot of the locule of the boll into which they are introduced, accompanied by a red staining. Infection is seldom found in the smaller bolls, as these are not normally fed on by the stainers. In the older bolls it has been found that the infection spreads more rapidly as the boll approaches its normal time of opening.

The Life-Cycle of the Insect.

The life-cycle of the insect varies little from species to species, and climatic differences, as will be seen later, chiefly affect the rate at which development takes place.

The eggs are laid in groups in the soil (or sometimes in heaps of cotton seed laid on the ground as bait), and after about a week the insect hatches as an immature stage known as the "nymph." Ballard states that in Queensland the first stage nymphs of *D. sidæ* do not feed, but other observers do not record this point. After the first moult, however, the nymph feeds on seeds and fruit of cotton, and various other plants which will be discussed later. It grows and moults alternately, until the adult stage is reached after the fifth moult. The nymphal stages usually occupy about one month. The adults have a short pre-mature stage, the length depending on temperature and food, and then they mate and the female lays groups of eggs at intervals. Adult life may last as long as four to six weeks, and the number of eggs varies from about one hundred in some species to as many as a thousand in others. Breeding slows off at certain times of the year when proper food is scarce, or when temperature

conditions are unsuitable, but there appears to be no definite "diapause" stage, either as hibernation or æstivation, when development is completely suspended.

The Relation of the Insect to Climatic Conditions.

A number of laboratory experiments and field observations made in different parts of the world tend to show that temperatures up to about 90° F. cause an increase in rapidity of development, but that above that temperature the death-rate increases and the rate of development remains the same or even is subject to slight retardation. It has also been shown that extremely high temperatures reduce the sexual activity of the adults and prevent pairing.

Low temperatures, on the other hand, produce a steady slowing-off of activity, but, although adults have survived several days on ice, there is no sign of a definite hibernation in any country.

Humidity also has an effect, and, in general, low humidities are injurious and high humidities beneficial to the insect. In districts subject to seasons of low humidity there is always a reduction of numbers at this period. It may be noted in this connection that there are no stainers in Egypt, Iraq, or in those portions of the Sudan where cotton is grown by irrigation in a rainless belt. The degree of sensitiveness to low humidity, however, varies from species to species, and in the Sudan the fact that *D. fasciatus* is found in districts where the three other injurious species are absent is considered as due to the great resistance of *D. fasciatus* to dry atmospheric conditions and low rainfall.

The effect of temperature is well seen in the Punjab, where the local stainer, known under the name *D. cingulatus*, has two periods of abundance and two of scarcity, the latter corresponding to the seasons of low temperature and very high temperature.

As the climatic conditions favourable for stainer multiplication—namely, high humidity and moderately high temperature—are also those favourable for the development of the cotton crop, there is a tendency for stainers to be numerous in years of a good crop and less numerous in years when the crop is reduced by unsatisfactory rainfall and temperatures. As a result of this association it is said that in certain parts of India the natives used to welcome the appearance of stainers in numbers as an indication of a high cotton yield. The better alternative of a still higher yield without the stainers was not, apparently, then in their philosophy.

Food Plants.

It is necessary, in considering the food plants of the cotton stainers, to distinguish at the outset between those plants on which the insects can develop and breed, and those plants which can support the adults for a considerable period without, however, permitting breeding. In the latter group are a very large number of plants, not properly studied, belonging to several natural orders and including Gramineæ, such as the seeds of maize, guinea-corn and millet, and some fruits such as citrus and mango.

The food plants on which stainers can breed are almost all members of the natural orders Malvaceæ, Sterculiaceæ and Bombacaceæ. Apart from cotton, some of the herbaceous food plants are of economic value—such as ochra (*Hibiscus esculentus*). Among the Malvaceæ the food plants include species of *Eriodendron* (Silk Cotton), *Thespesia*, *Hibiscus*, *Abutilon* and *Sida*; in the Sterculiaceæ, *Sterculia* and *Brachychiton*; and in the Bombacaceæ, the most important is *Adansonia digitata* (the Baobab). Even on those foods on which the insect is able to breed it is necessary that the plant should be in the correct stage of development before this can happen. In the case of cotton the smaller nymphs can feed and can develop to the adult stage on green bolls, but the older the bolls the more rapid is the development. For the adults to become sexually mature and lay eggs, a diet of older bolls or seeds is essential in some species. On other plants much the same holds, and the breeding season on different plants depends, therefore, on the length of time that each plant has developing fruits or exposed seeds. An extreme case is that of the baobab, on which *Dysdercus fasciatus* feeds, as in this tree the seed capsules are too hard for the stainers to pierce, and they can only feed when the capsules are open. This usually happens when the capsules fall to the ground, and as the seeds persist for a long time, almost continual breeding can take place in the seeds on the ground, but little or none on the tree. Breeding and development can also take place in all species on cotton seeds removed from the plant.

It is this sequence of food plants, combined with the migration from one to another which will be discussed later, that makes the control of the stainers so difficult. In any district the alternative food plants of each species of stainer must be studied, and their distribution, ecological relationships and periods of flowering and fruiting must be known before the possibility of controlling the pest by destroying alternative food plants can be considered.

The insects appear in some cases to exert definite preferences in

the choice of food, and Ballard in Queensland has shown that plants of *Abutilon* growing among cotton may have a considerably higher stainer population than the surrounding cotton plants.

The state of the development of the food has a definite effect on the fertility of the adults. Pope in Peru showed that females of *D. ruficollis* fed on old bolls produced twice as many eggs as those fed on half-grown bolls, while Ballard says that in the case of *D. sidæ* on cotton in Queensland no pairing takes place until the insect has had seeds on which to feed.

Changes in Population

As a result, on the one hand, of the varying attractiveness of the cotton plant itself and of the alternative food plants, and, on the other hand, of the varying climatic conditions, the number of insects on the growing cotton, and hence the potential damage, varies greatly from month to month and from year to year. Actually, as we do not yet understand all the factors, we reverse the relationship and try to use a knowledge of the numbers of the insect to infer the causes.

For many years estimates of the numbers of stainers in the cotton fields have been made, some quite haphazard, others continued regularly and based on definite statistical principles. The older observers often used as a measure of abundance the numbers captured by boys in the process of hand collecting for control purposes. It is necessary, however, to realize that if a large proportion of the stainers are collected on an area one week the number captured during the next week will merely be a measure of hatching+immigration+dispersal, and as the two latter will depend on the size and isolation of the area sampled, the results may be merely a measure of these factors. This would be useful for comparing results from the same plot at other periods, but not of much value for comparing different plots. If the normal increase on a plot is to be studied a number of small samples should be taken at random throughout a large area, and the numbers of insects destroyed or removed (if any) should only be very small in comparison with the numbers on the whole field. Samples of this type are now being taken in some localities. On the other hand, if the question of immigration only is being studied, then at each count the population should be reduced as nearly as possible to zero. Such population estimations should be repeated at regular intervals, and should be carried on not merely from month to month during one season, but from year to year, so that the combined effect of climatic conditions on numbers in the field can be studied on a sound basis.

A good example of the use of the statistical method for studying immigration is given by Golding, who is able to show that in Nigeria the banded form of *D. superstitiosus* appears on the cotton in September before the spotted form; that the latter, however, comes in increasingly greater numbers, so that in November it is more than ten times as abundant as the banded form; and that the banded form increases in numbers in January when the spotted form is leaving the cotton.

MIGRATION.

The so-called migration of the insect from one food plant to another is of fundamental interest from the economic point of view, yet little accurate information appears to be available. It can be conveniently divided into three problems. (1) The cause of the start of the migration from the previous host plant, (2) the distance that can be flown and if the flight is in any particular direction, and (3) the cause of attraction to the cotton fields and the distance at which this attraction can exert an influence.

A good account has been given of the starting of a migration of *D. sidæ* in Queensland by M. C. Evans, but much more information is needed. Evidence at present seems to indicate that a migration starts (given suitable climatic conditions) when a number of insects reach the adult stage at a time when the food supply is becoming unsuitable either in quantity or quality.

Once the flight has started it appears to continue until a suitable food plant—which may by chance be a cotton field—is encountered. There is no evidence of the maximum distance that can be flown, but marked specimens have been recovered in Nigeria a mile away from the point of liberation within eighteen hours, and a clearing of all alternative food plants for one and a half miles in all directions from a cotton field in the same district made no difference whatever to the population of that field. With the information available on the distance migrated by other insects there is no reason to suppose that the stainers could not fly for ten to twenty miles if they did not previously meet a suitable food supply. Withycombe suggests that the main migration in Trinidad may take place at night, but the close correlation of flight activity with high temperatures and sunshine observed by other entomologists makes this unlikely. Except for one statement that in Nigeria the main direction of flight there is towards the South in October, November and December owing to aridity, there seems to be no information as to any general direction of movement in any one locality during these migration flights.

As the time of starting of a flight appears to depend on a condition of the food plant left behind, the time of arrival of the insect on the cotton crop cannot depend on any condition of the cotton crops, except in so far as that condition is related phenologically to the condition of the previous host, and in so far as the insects will not presumably settle on the crop at all unless it is attractive. There is, therefore, the probability that the time of arrival of the insects in the cotton field is not dependent on the state of the cotton crop, although whether they remain or pass on depends on the attractiveness of the cotton. From all accounts the attractiveness appears to increase as the bolls grow older, and is at its maximum when the bolls are opening and the seeds at first exposed. Laboratory experiments show that adult stainers are sensitive to the presence of cotton seeds, and, indeed, these are used as traps in the field, but there seems to be no evidence that the scent of a cotton field is attractive from any great distance, or that the insects normally arrive at the field upwind, which one would expect to happen if this were so.

Natural Enemies.

Up to the present no efficient natural enemy has been discovered in any part of the world. In spite of the fact that the insects would be considered by naturalists as having a "warning colouration" they are eaten by various species of birds in different parts of the world, but not to a sufficient extent to be of any practical value. In Nigeria, India and Queensland predacious bugs of the family Reduviidæ have been recorded feeding on the stainers. Some of these so closely resemble their prey in general appearance that they are often collected by mistake and destroyed in the process of hand picking.

Diptera of the family Tachinidæ have also been recorded as attacking stainers in India, Australia and parts of Africa, but in their present homes appear to exert little or no influence on the numbers of their hosts. In some cases it has been found that the stainer can mature and even lay a small number of eggs when the parasitic larvæ are present in the abdomen. Thus the introduction of the fungus in the process of feeding would be but little reduced. Myers has suggested the transfer of some of these Tachiniidæ to the West Indies, but they would have to exert a much greater influence in their new home to justify the experiment.

Mites have been recorded as parasites on stainers in various parts of the world, and in the West Indies the fungus *Sporotrichum globuliferum*, known in the United States as the "Chinch Bug Fungus,"

has been found killing adults. This fungus has been used experimentally in the United States to control outbreaks of the "Chinch Bug," but it did not prove successful, and is unlikely to be of the slightest value in cotton stainer control.

CONTROL.

As cotton can be grown as an annual crop, early efforts at control of stainers included the use of a "close season" sometimes enforced by legislation; this took the form of a period of three or four months between picking and replanting, during which no cotton plant was allowed to be in the ground. This method alone failed owing to the powers of the insect to migrate to alternative food plants, but in St. Vincent, an island in the West Indies about fifteen miles long by about ten miles broad, the attempt to starve out the stainer was, in 1917, carried a step further by the destruction throughout the island of all the alternative food plants; a measure only, of course, possible owing to the relatively small area and isolated position of the island. At a cost of about £300 about 1,500 silk cotton trees (*Eriodendron anfractuosum*), 11,500 John Bull trees (*Thespesia populnea*) and several thousand seedlings were cut down. The immediate result was a reduction of the numbers of stainers collected on the plots at the Agricultural Experimental Station from over two hundred thousand from July, 1916, to January, 1917, to twenty-four individuals for the same period one year later.

The outstanding success in St. Vincent has resulted in similar experiments elsewhere. In Nigeria an area of country three miles square was cleared of all alternative food plants with the disappointing result that the infestation on a cotton plot in the centre of the area was six to ten times as heavy as in a control plot just outside the cleared block.

In spite of these contradictory results the method does hold out some possibility of control, and the entomologists in the Sudan recently claimed considerable reduction in numbers of *D. fasciatus* following on the continued cutting back of the baobab trees. In this district, however, the baobab forms practically the only alternative food plant of *D. fasciatus*.

Another control method that seems to have been of some value is the collection by hand or by net of the insects themselves. The method is, of course, dependent on an ample supply of cheap labour. The use of traps of heaps of cotton seed considerably assists the method of hand collecting by concentrating the individuals, but

owing, apparently, to the small range of attraction the method loses much of its possible value. Further work on the extraction of the attractive agent from the seeds is much needed. Withycombe apparently made a start in this direction, but no serious continued investigation has been carried out.

Suggestions for Future Work.

The survey of the stainer problem just made shows little hope of immediate improvement in the situation. It does, however, indicate several lines of work on which much more information is greatly needed.

In the first place a thorough systematic study should be made of the genus *Dysdercus* in some museum such as the Natural History Museum in London, with the co-operation of all field workers sending in material captured at all times of the year and on various plants. In connection with this part of the work an attempt should be made to settle experimentally, either in England or abroad, whether certain of the variations which exist in the field are comparable with the " phases " of locusts, and if, therefore, the migratory habit is directly correlated with previous overcrowding, or alternatively is merely due to a shortage of suitable food supply.

On the mycological side more work appears to be needed on the source of the internal-rot fungi. Since only the later nymph stages and adults appear to be capable of transmitting the disease, there must be some supply of the fungus quite close at hand, in order that the immigrant insects can bring the infection to the cotton fields. The fungi must also have a sequence of host plants throughout the year just as the insect itself requires.

The problem of the migration of the insect, as, indeed, the problem of all insect migration, is full of unknown factors. One would like to see more careful observations on the commencement of a migration, and further marking experiments to see how far the migrants can move and in what direction. More chemotropic work might also give us better information as to the distance at which the insects are definitely attracted to cotton fields, as opposed to their reaching the field by accident or in random cross-country flight, and might even produce an efficient trap bait.

In connection with the problems of alternative food plants more information appears to be needed on the length of time on which stainers can survive on certain plants (Gramineæ, for example) without breeding.

Work on the above, by no means easy, problems cannot be guaranteed to lead to a solution of the planters' difficulty in controlling the ravages of cotton stainers in the field, but at least it would make that solution, for which we all hope, more likely to appear and to be more firmly grounded.

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THE SUPPLY OF HUMUS TO SOILS

BY

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INTENSIVE cropping depends on the maintenance of the proportion of soil humus at a high level. Recent studies on the humification of plant residues have simplified the making of composts, the basic principles having been discovered by Russell and Richards,[13] and Hutchinson and Richards,[11] and elaborated by Waksman [17] and others. The processes for making "Adco" and "Edelmist" manures, as well as several others, for efficient composting of farm wastes (particularly straw), followed quickly, India producing the valuable work of Howard,[8] Carbery and Finlow,[3] Fowler,[4] V. Ayyar,[16] and Howard and Wad.[10] Thus scientific results have led to economic practice. The practicability of conserving initial nitrogen and of making up slight deficiencies by natural fixation during decomposition have been demonstrated in the Indore process and subsequent work at the Institute.

The essentials for practical and efficient composting to secure adequate humus supply are: (1) Aerobic conditions, since humus is an aerobic product; (2) maintenance of optimum temperature ranges, moisture and adequate nutrition for the different organisms operating successively; (3) cheapness, simplicity and enough flexibility to suit any farming system; (4) cleanliness and sanitation are also desirable.

The standard Indore process—which grew out of a long study by Howard of the problems of humus production, culminating in a concentrated attack described by Howard and Wad*—actually fulfils these conditions. The process requires no skilled supervision; all adjustments of nitrogen and carbon, moisture, temperature and air, automatically follow if the technique is observed. It can be worked on any scale. The use of pits under dry conditions for the greatest economy of water, and of heaps under humid surroundings, has been fully justified by experience. Weed seeds are completely destroyed.† Compost is produced at a lower cost than that claimed for any

* *The Waste Products of Agriculture: their Utilization as Humus*, Oxford University Press, 1931.

† Messrs. Coleyana Estates, Ltd., Okara, Punjab, write: "Weeds are kept down to such an extent that a shortage of this material is feared."

other process. Lastly, it has successfully stood the test for elasticity, being adaptable to varying local conditions as will be shown below. The process is already a routine measure with many of the large and also some of the small cultivators, and several agricultural companies have praised it enthusiastically.* In addition, it has been established on all Government Farms in the United Provinces, and, on a co-operative basis, in a "better farming village," and also has been in operation on the Sakrand Experiment Station in Sind since 1930, where the compost is found to increase crop yields and to suppress alkali.

It has been found, however, that the standard process gave to many small Indian cultivators an impression of complexity, which has hindered its spread among this class. Still greater simplicity is needed, even if some sacrifice of nitrogen or of output is involved. The utmost conservation of carbon and nitrogen and a continuous supply of manure, both given by the standard technique, are necessary only where a highly intensive agriculture is practised. About four-fifths of the cultivated land in India is dependent upon rainfall lasting only a few months. Agriculture in this vast tract and other climatically similar parts of the sub-tropics is generally of the extensive type, and the universal need is for large quantities of cheap humus.

Rain-watered Compost.

Successful attempts were made in 1931 to make composts with a few simple operations and rain-water alone, and were followed by large-scale routine manufacture in 1932 and 1933. Appendix I gives the detailed technique. Farm wastes collected mainly in the dry months are used throughout the year for cattle bedding where possible, and, with dung, urine-earth and ashes, are exposed in heaps to the rains. Three turns provide aeration, and the growing of suitable legumes on the moist heaps between turns hastens rotting. The return to the field of its own wastes is thus literally practicable if the heaps are made on its edge.

This modification is perhaps the greatest achievement of the Indore process, and by its use the quantity of manure produced on a holding can easily be doubled or trebled, according to the quantity of wastes which can be collected. Within four months a compost

* **Messrs. Coleyana Estates, Ltd., Okara, Punjab, write: " . . . the process was so simple that no difficulty was experienced in teaching the local labour to carry on the work . . . is now a regular part of the farm routine and has proved distinctly advantageous."**

results containing 0·9 to 1·25 per cent. nitrogen, potash up to 3 per cent., and phosphate about 0·5 per cent. Up to 99·5 per cent. passes a sieve of three meshes per linear inch and 97 per cent. through one of six meshes. The balance of nitrogen and organic matter is shown below.

TABLE I.—BALANCE OF NITROGEN AND ORGANIC MATTER IN THE RAIN-WATERED COMPOST PROCESS.

	Dry Matter in Lbs.	*Nitrogen Per Cent. (on Dry Weight).*	*Total Nitrogen in Lbs.*
Initial charge in heaps	24,862	0·78	193·44
Compost	10,650	1·04	111·69
Total Loss of Nitrogen in Lbs.	*Per Cent. Loss of Nitrogen.*	*Per Cent. of Compost to Charge.*	
		Fresh (55·8 Per Cent. Moisture).	*Dry.*
81·75	42·26	73	43

In comparison with the standard process, decomposition temperatures are lower, fungus growth is sluggish and scanty, yet crumbling is equally rapid, this being due apparently to other organisms. Four inches of rain penetrates about 6 inches into the heap, raising the moisture to 75 per cent., further rain soaks no deeper unless a turn is given. Decomposition accelerates surprisingly following timely turns; with 5 inches of rain before the first turn and 10 before the second, crumbling is far advanced. This brings areas of low rainfall within range, and indeed in the standard process the water required, being intimately incorporated and conserved, is equivalent to only about 16 inches of rain over the area of the pit. Effective rainfall of less than 20 inches (controlled by covering the heaps) gave satisfactory results in 1933. Better use of low rainfall would follow initial exposure in shallow heaps, making two into one at the first turn.

The speed of fermentation determines water requirement. Uniform, rapid soaking, frequent aeration by turning, and growing legumes on the heaps between turns, all promote quick decay and water economy.

Canal-irrigated Areas of Low Rainfall.

Regular watering, prescribed by the standard process, is often impracticable in tracts having only intermittent canal flow. A modification, detailed in Appendix II, successfully meets these needs,

the main features being: (1) Cattle bedding, dung, urine-earth and ashes are deposited daily in a trench 2 feet deep; (2) when water arrives, the accumulated mass is given a rapid start by thorough soaking, followed by inoculation and turning, to aerate; (3) subsequent soakings and turnings maintain intense fermentation; (4) full turns (instead of the standard half-turn) permit direct watering by flow with minimum seepage loss; (5) the sequence of operations harmonizes with farm routine and canal flows.

This modification is reported to be working successfully at the Bikaner State Farm in the Gang Canal irrigation colony.

Intensive cultivation may involve limited space for permanent trenches, and sites alongside irrigation channels are often salty or water-logged. Continuous chains of temporary heaps in cultivated fields suit these conditions, minimizing space and exposure. Such heaps at Indore, with shade temperatures up to 110° F., required 50 inches of water; they started sluggishly but decayed rapidly after the second turn. Nitrogen content was normal and output only 10·6 per cent. less.

Compost Aided by Nitrogen-Fixing Organisms.

In rain-watered heaps with excess of cotton and sorghum stalks and sugar-cane trash, decomposition is slow, owing both to low nitrogen content and to defective physical texture with associated uneven aeration and moisture. In 1932 the leguminous *sann* hemp (*Crotalaria juncea*) was grown on such heaps to add nitrogen by fixation. The plants grew only a foot high, but developed a dense mat of roots crowded with nodules. After turning, the heaps decomposed to excellent compost as rapidly as those of mixed wastes.

Further tests confirmed these observations, which showed the practicability of (1) intensive nitrogen fixation in routine composting and (2) easy decomposition of refractory wastes poor in nitrogen, like cane trash, without admixture of better material. *Sann* gave better nodule-development than other legumes tried and was best sown after the first turn. Evidently the quickened decomposition was due, at least partly, to the nitrogen fixed by the *sann* hemp.

An old problem with sugar-cane growers is the disposal of trash—usually burnt, with complete loss of valuable organic matter. This material, difficult to rot because of its low nitrogen content (about 0·3 per cent.) and its tendency to pack densely, is now yielding to suitable modifications in treatment, including the growth of *sann* hemp as a nitrogen fixer. The technique is being adjusted to suit the needs of both large and small growers.

THE AIM IN HUMUS MANUFACTURE.

The supply of humus to soils is sometimes confused with the replenishment of soil-nitrogen, and the value of composting methods is then measured in terms of nitrogen content. The rôle of humus is specific, and composts should not vary widely in composition from natural soil organic matter. To save waste additional nutrients should be applied separately, according to the special needs of each crop. Organic preparations rich in nitrogen should be classed as top dressings rather than as humic composts, which are intended to maintain a healthy physical condition in soil,[1] so ensuring an optimum environment for physico-chemical and micro-organic activities congenial to crop growth.

Nitrogen recuperation in Indian soils is rapid, and except in areas of high rainfall minerals are ample for the crops usually grown. Both in Bihar soils growing indigo[6, 7] and in the Malwa black cotton soils,[9] low yields or crop failures appear to be due mainly to the deterioration of soil texture, as a direct result of monsoon conditions. A recent (unpublished) experiment at Indore showed that by merely preserving an open texture in the soil, yields of Indian cottons could be doubled and of American varieties, trebled. The present capacity of soils to nourish crops should be utilized thoroughly before the question of the addition of nutrients arises. Agriculture in tropical and sub-tropical areas—both old and new—has a long way to travel to reach this stage.

Plants require a solution of inorganic nutrients in the soil as well as in the culture-jar. No organic plant food is necessary. It is primarily its power to create and maintain healthy soil texture that enables humus to increase the soil's efficiency in producing such solutes, whether from its own components or from applied manures. It is apparent, also, that humus serves as a self-adjusting container for these nutrient solutions. Aided by these beneficent functions, it is natural that crops should enjoy freedom from disease.

For the maintenance of fertility under arable conditions the requirement of soils for humus varies. It is high in humid[12] and irrigated[2] areas of luxuriant growth, but very low in arid zones,[14, 5] which is fortunate for dry-land farmers, because the possible natural sources of replacement are scanty. Transport difficulties disappear when sufficient compost can be made in the field from its own crop residues by a modification such as the rain-watered process described.

Recent trials at Indore show that the permeability of black cotton

soils is nearly doubled when dressed with compost—an important factor in reducing erosion. Losses of nitrogen are reduced. A steady supply of nitrified nitrogen is assured, both on black soils and also on sandy soils. (See Table II.)

TABLE II.

A. THE INFLUENCE OF COMPOST ON SOIL.

	Relative Permeability.	*Nitrified Nitrogen found under Monsoon Conditions (Mgs. per 100 Gms. of Soil.)*			
		21 *Days.*	42 *Days.*	63 *Days.*	109 *Days after Application.*
Heavy black cotton soil:					
(i.) Without compost ...	1·0	1·93	2·32	1·98	1·03
(ii.) Compost added at 14 tons an acre = 17 lbs. N. an acre ...	1·7	2·30	4·95	3·45	2·63
Light sandy soil (Jaipur):					
(i.) Without compost	—	1·32	—	—	0·52
(ii.) Compost added at 14 tons per acre = 17 lbs. N. per acre	—	4·90	—	—	1·52

B. THE INFLUENCE OF COMPOST ON THE YIELD AND DEVELOPMENT OF MALVI COTTON.

	No. of Plants Observed.	*Average Yield of Seed Cotton in Gms. per Plant.*	*Average No. of Mature Bolls per Plant.*	*Weight of Seed Cotton per Boll in Gms.*
Black cotton soil:				
(i.) Without compost	85	3·9	3·5	1·10
(ii.) With compost ...	73	9·1	5·0	1·79

In the cotton crop this leads to fuller boll-development and double or treble yields, according to variety. The first step in reducing cotton production costs must, therefore, be efficient utilization of all wastes for humus manufacture.

The authors feel confident that suitable adjustments in composting can easily be made for any conditions if care is taken to preserve intact the fundamental conditions favourable to the right type of micro-organic activity.

APPENDIX I.

Rain-watered Compost from Farm Wastes: Detailed Technique.

Materials.

(1) *Mixed farm wastes* of all sorts—weeds, stalks of cotton, pigeon-pea and sesamum, any inedible or unwanted threshed straw and chaff, sugar-cane trash, stumps of sorghum, millets, maize and sugar-cane and uneaten fodder residues. Hard materials need cracking; spreading them on a road or cattle track does this, even if on soft land.

(2) *Dung* of cattle, horses, sheep, goats or camels—about 1½ cubic feet at least per cart load (35 cubic feet) of wastes. Larger quantities may be used safely, but excess is uneconomical.

(3) Ordinary *field soil*, preferably taken from where cattle usually stand, whether in a shed or outside—having absorbed urine it is rich in nitrogen. About 3 cubic feet per cart load is enough.

(4) Wood or vegetable *ashes*, if available, should be added to enrich the compost in potash and to neutralize acids produced in rotting. One cubic foot per four cart loads is a suitable quantity.

Method.

Making the Heaps.—Mixed wastes (say a cubic yard per bullock) are spread where the cattle usually stand and are renewed daily or every few days. If cattle dung is required for fuel, as in India, up to three-quarters of it can be reserved at this stage—the remainder will be enough for the compost and should be scattered over the bedding before its removal to a convenient well-drained site, where it is made into a heap 8 feet broad, 3 feet high and of suitable length. It should be built to full height in three days to allow the dung to dry rapidly, unless it is actually rainy weather.* The necessary soil and ash may either be thrown on top or added in the cattle shed.

It is not essential to use the wastes as bedding, but a mixture of several kinds is very desirable (there are often difficulties in composting single wastes), and, of course, the soil and dung must be added. If urine-soaked earth is not readily available ordinary soil may be used, with more dung.

First Turn.—When rain has penetrated the heap to 6 or 9 inches depth it is turned with a fork to make a fresh heap at one side or one end of the original heap. The object of this is to mix the wet and dry material; further rain then soaks in better.

Second Turn.—After about a month the heap is turned back to its former position.

Third Turn.—About a month later the last turn is given.

Turning distributes moisture and ensures aeration; it should be done on a rainy or cloudy day to check evaporation.

* There are indications that nitrogen may be lost quickly from fresh moist cowdung.

The time-table suits a normal rainy season in Central India; if rain is deficient turning should be delayed, and if the heap is not well rotted a fourth turn should be given. The compost is generally ready to use in four months; three cart loads of wastes will make more than a load of compost.

In areas where rainfall is apt to be uncertain, the process is more rapid if a leguminous crop (*sann* hemp is found most suitable at Indore) is sown on the top of the heaps after the first turn. Whatever growth it makes is mixed with the rest of the heap at the second turn and promotes rotting. If in a district of low rainfall the heap at any stage is obviously too dry for rotting, it may be spread in a shallower layer when rain is falling and, when soaked, built up into a heap again.

APPENDIX II.

Compost from Farm Wastes in Canal-Irrigated Areas: Detailed Technique.

The materials and method are those described in Appendix I. up to the stage of removal of the farm waste bedding from the cattle shed, but instead of building heaps a trench is used, 2 feet deep, 15 feet broad and of sufficient length. This should be dug within reach of an irrigation channel and close to the cattle shed or standing. It is unwise to place it near a main supply channel for fear of water-logging by seepage. Forty-five feet length will deal with one cart-load of wastes daily throughout the year, plus an extra 10 feet for turns.

Starter.—When beginning the process in a new place a little old farmyard manure should be added to the first charge as a "starter"—about $1\frac{1}{2}$ cubic feet per cart load of wastes is enough. Afterwards that quantity of material taken from an actively rotting heap just before the second turn should be used, adding it when the first turn is given.

Charging.—The bedding should be filled into the trench till it stands 6 inches above the edge, successive lengths being charged each time the cattle-shed is cleaned, and no space left between the charges. The first charge should begin 10 feet from one end of the trench, leaving that length empty.

Water Supply.—At each watering the material should be soaked thoroughly. This may be done either by throwing water on it from the channel, using a suitable vessel, or by allowing water to flow from the channel, spreading it over the charge in the trench by using small movable channels of sheet iron to guide it to different parts.

First and Second Waterings.—As soon as the canal next begins to flow, *soak* all the initial charges twice during the flow period.

First Turn.—The "starter" is scattered over the charge, then with a fork or other implement the material is turned back on to the vacant portion of the trench so that the whole charge is moved 4 or 5 feet. Space is so left for the turning of the next charge.

Third or Fourth Waterings and Second Turn.—At the next period of canal flow two more soakings should be given to the turned material, followed by another turn (the second) in the same way as the first, so moving the heap another 4 or 5 feet in the same direction.

Fifth and Sixth Waterings and Third Turn.—At the next canal flow the material is soaked twice as before, thrown out of the trench on the side opposite to that used for watering and charging, and made into a heap 3½ feet high, 10 feet broad and of the required length. By this time the material should crumble easily and be dark brown in colour. The manure may be expected to be ready about a month after the third turn without any further attention.

TIME-TABLE.

This will naturally vary according to the rotation of canal water in each district, but, assuming the canal flows once a month for ten days the time-table of operations will be as follows:

First and Second Waterings.—All the initial charges are allowed to accumulate until the canal flows and are then soaked at the beginning and at the end of the flow period.

First Turn.—Immediately after this.

Third and Fourth Waterings.—At the beginning of the next flow period, on two successive days.

Second Turn.—The day following.

Fifth and Sixth Waterings.—At the beginning and end of the next flow.

Third Turn.—After the flow period is over and when the work of giving the first turn to the new charge is finished.

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A TENTATIVE ACCOUNT OF THE MOVEMENT OF FOOD MATERIALS DURING THE DEVELOPMENT OF THE COTTON PLANT

BY

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It is remarkable how little interest botanists have evinced in the past in the process of food transport in the plant. It has been quite otherwise with the process of water transport, which for many years has attracted an enormous amount of research. There are signs, however, that a change is at hand, for which the agricultural importance of the problem of the translocation of food materials is probably responsible. A great deal of time has been devoted to this problem at the Cotton Research Station in Trinidad, and it may be of interest to give an outline of the progress made.

It will be well to preface this outline with an account of the life-history of the Sea Island cotton plant under West Indian conditions. The growth cycle extends over a period of about six months. During the first three months the plant is predominantly vegetative, while during the last three months its activity is mainly devoted to the manufacture of bolls. It is during the vegetative period that nearly the whole of the plant's mineral supply (nitrogen, phosphorus, potassium, etc.) is absorbed by the roots; as soon as the plant becomes loaded with bolls, this uptake of mineral elements receives a check. The size of the crop is thus, in a large measure, determined by the conditions prevailing during the vegetative phase.

During this phase a large proportion of the sugar manufactured in the leaf travels to the root, where it is utilized in growth and in supplying the energy consumed in abstracting the mineral plant food from the soil solution. The concentration of these mineral materials in the root is generally greater than in the soil, and work, of course, must be done in concentrating any solution. The mineral elements thus absorbed travel up the wood with the transpiration current. As the bulk of the transpiration stream moves to the leaves in virtue of the great pull of these organs on the water in the plant, so the bulk of the mineral salts also travels to them. On arrival in the

leaf all the mineral salts are concentrated as a result of evaporation from the leaves, while some (*e.g.*, nitrogen) are also chemically transformed.

It thus happens that the leaf is not only supplied with sugar as a result of carbon assimilation, but as a result of transpiration it also obtains the bulk of the mineral elements absorbed by the roots. *Thus the leaf is the main distributing centre of sugars and of mineral food materials.* During the vegetative phase the plant stores large amounts of the mineral elements, even when one or more of these elements is limiting vegetative development. This storage occurs very largely in the leaves, but there is also storage in stem and root. As the plant becomes loaded with bolls, sugar is diverted from the vegetative plant, including the root, and travels to the bolls. With the cessation of sugar supply to the roots their growth is checked, and the uptake of mineral elements from the soil rapidly declines. To obtain their supply of mineral plant food the bolls have recourse to the mineral elements stored during the vegetative phase of development. Gradually the bolls drain the vegetative plant of its food materials. The leaves yellow and fall off as nitrogen, etc., is drained away, and as the strain increases the flower-buds and bolls themselves are starved and are shed. The plant fruits itself to senescence.

We have now to enquire into the way in which materials are distributed from the leaf, and for this purpose may consider how sugar travels from the leaf to the boll. The sugar (cane-sugar) synthesized in the green leaf cell moves into the fine veins. It has been found that the concentration is much lower in the green part of the leaf than in the veins. This movement of sugar from a region of low to one of high concentration differs from anything yet observed outside living organisms. Work must be done in this concentration, and oxygen should be consumed. The phenomenon is termed secretion, and, as movement takes place in only one direction, transport from leaf lamina to vein is said to be polarized.

The actual channel for longitudinal transport is the sieve-tube. These are long, narrow cells which communicate with one another through the sieve-pores. They lie embedded in a compact tissue termed the phloem, which is situated inside the veins. The phloem extends all the way to the boll and traverses the bark of leaf-stalk, stem and flower-stalk. Longitudinal movement through the sieve-tubes differs from entry into them from the leaf lamina in that the direction of transport is not polarized; it occurs in either direction, but is always from a region of high to one of low concentration. The diversion of sugar transport to the boll is due to the

fact that the sugar concentration in the boll is maintained very low; as soon as sugar arrives it is utilized in growth, and growth is very rapid. It is in this way that the bolls drain the plant of its sugar and divert it from the root, etc. The most arresting fact about transport in the sieve-tube is the enormous speed achieved, the rate being about 20,000 times as rapid as movement due to physical diffusion. The manner in which this is accomplished is not yet clear.

A few facts about the mechanism of this high-speed transport in the sieve-tube are, however, known. Movement always occurs from a region of high to one of low concentration, and work must be done in accelerating diffusion. Transport is protoplasmic and may be fundamentally akin to secretion. Oxygen, of course, must be consumed during movement, and the method of oxygenation presents interesting features. It appears to depend on oxygen-carrying bodies, that is to say substances akin to the hæmoglobin of the blood. This system of oxygenation is rendered necessary by the compact nature of the phloem, which, unlike most plant tissues, is without intercellular spaces. This compactness is required to withstand the enormous turgor pressures developed in the sieve-tube system. These are generated by high concentrations of sugar, and high concentrations of sugar assist in moving large quantities of material and arise as a result of the secretory machinery already described in the fine veins of the leaf. The oxygenation of seed and lint may also depend on oxygen-carrying bodies.

We have next to consider the way in which mineral elements are distributed from the leaf. Of the seven so-called essential ones, nitrogen, phosphorus, potassium, sulphur and magnesium are mobile in the phloem, and are therefore exported from the leaf, while calcium and apparently iron are not phloem mobile and remain in the leaf. Chlorine, which is generally not considered essential for growth, is also phloem mobile. Preliminary tests indicated that traces of calcium might be present in the sieve-tube system of the cotton plant. Further work on the sap exuded from the sieve-tubes of other plants has not confirmed this, but shows that only mobile elements, including chlorine, are present in appreciable amounts. It may be that all the elements in solution in the sieve-tube are mobile, and that calcium cannot obtain admission, and for this reason is immobile.

The behaviour of potassium, magnesium and chlorine differs from that of nitrogen and phosphorus in that they escape from the phloem and leak readily into the woody cylinder of the stem. It is thus at times difficult to obtain evidence of their mobility by the usual ringing

methods, as removal of a ring of bark does not always lead to an accumulation of these elements above the ring. They leak into the transpiration current and travel back again to the leaf.

Finally, it is interesting to note that as the flower corolla changes its colour from yellow to red prior to abscission there is a rapid backward movement of the mineral elements. It has, of course, long been known that there is a backward movement of mineral elements from the foliage leaf prior to leaf fall; that there is a similar exit of materials from the corolla is of great importance.

Sugars and the mineral elements are not the only materials that are exported from the green leaf. There are, for example, the hormones, which regulate and initiate growth, and are probably a factor in boll shedding, but little can yet be said concerning their transport, for even the channel used is still uncertain, and, naturally, nothing is known concerning the mechanism involved.

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COTTON STATISTICS

BY

JOHN A. TODD, M.A., B.L.

The new arrangement of the statistics begun in our last issue is now settling down, and we give here a list of the tables showing the issues in which each will appear. The table of the Empire Crops supplied by the Empire Cotton Growing Corporation will appear in the July issue each year.

	January.	*April.*	*July.*	*October.*
World's Crops	×	—	×	×
American crop	×	—	×	×
Indian crop	—	×	—	×
Indian crop by varieties	—	—	×	—
Egyptian crop	×	—	×	—
Egyptian crop by varieties	—	—	—	×
Sudan crop	—	×	—	—
World's consumption (Federation) ...	×	—	×	—
World's consumption (Garside)	—	×	—	×
U.S. consumption	×	×	×	×
World's Carryover, American	—	×	—	×
World's Carryover, Egyptian	×	—	×	—
Futures prices, American and Egyptian ...	×	×	×	×
Spot prices, other varieties	×	×	×	×
Prices, season's average	—	—	—	×

As there is not very much change in the World's Crops this time, and the semi-final (March) estimate of the American crop will not be available in time for this issue, we have thought it desirable to utilize the space this time for a table of the Sudan crop, which has never been given before in these statistics. This is of special interest because of the unfortunate fluctuations in the yield in the Gezira, which has become a very uncertain factor in each year's crop. As the result of these fluctuations the authorities have, since last year, decided not to give any estimate for the Gezira until a later stage, but private estimates indicate a total yield for the Gezira this year of about 500,000 kantars. In future years only the latter part of this table will be repeated.

World's Consumption.—As the details of the Federation statistics may not be available in time for this issue, we give instead a table compiled from Garside's statistics. The advantage of his figures is

that they appear monthly instead of only half-yearly, so that they show the progress of consumption throughout the season, but for convenience of comparison the Federation half-yearly totals are also shown. The critical point of the monthly figures is that the heavy consumption of American cotton in the United States tailed off very sharply from the high figures of last summer, so that November and December actually showed figures less than a year ago. January, however, made quite a good recovery. The consumption of American in the rest of the world was better maintained than in the United States, especially in the Orient, while that of Outside Growths also showed much higher figures than last year throughout. The result is that, according to Garside, the consumption of American during the first half-season was running at the rate of fully 14,000,000 bales, or practically the same as last year's total, while owing to the increased consumption of Outside Growths, the world's consumption of All Kinds is likely to be well above 25,000,000 bales for the first time since 1929.

U.S. Consumption by Varieties.—This table gives further details of the consumption in America and emphasizes the contrast between the recent figures and the record figures of the last three months of the previous season.

World's Carryover of American Cotton.—The critical point in this table is the turn of the season about December. Usually the Monthly Total reaches its highest point at the end of December, but in some seasons the turn comes with the December figure showing a reduction, and that usually results in a considerable reduction of the Carryover at the end of the season. It will be seen that this year the increase in December was negligible, and January showed a very heavy reduction, so that this year may be placed in the category of good seasons. A comparison of the crop figure with the probable total consumption, judging by the recent trend of the figures in Table IV., confirms the prospect of a reduction of about a million bales in the Carryover at the end of this season.

Indian Crop.—This table gives most of the available details with regard to the Indian crop for the last six years. These show so far a much smaller recovery than had been expected this year, but these figures are, of course, only the so-called " Final " estimate in February, which is subject to considerable revision in the Supplementary estimate in April. The table also gives the figures for the Commercial Crop so far as available, but these are, of course, a year behind. There is little doubt, however, that the figure for 1932 will maintain the very marked discrepancy

between the Government estimates and the Commercial Crop figures.

Futures Prices.—The markets have been passing through a very hectic time since our last issue, mainly as the result of financial developments in America. The result is that in January New York registered a new high level for the season, and in February went well beyond the record of July last, which, incidentally, was the highest price touched since August, 1930. Liverpool, however, has lagged behind on the rise, which was largely due to inflation in America. Egyptian prices have also been subject to very erratic movements during the past three months. The result has been, on the whole (as will be seen from the percentages in the next table), that Sakel for a time appreciated substantially against American, while Uppers has depreciated very considerably, and is now at the lowest relative level since 1930.

Spot Prices of Other Varieties.—The sympathetic rise of American prices in Liverpool has not been fully reflected in the prices of other varieties, with the result that since December their percentages have been a little lower, especially Indian. Practically the only exceptions were Tanguis in December and, as already mentioned, Sakel, which also reached its highest point in December. Both, however, have lagged behind the latest rise of American, especially in February.

SUDAN CROP.

	1927–28.				1928–29.				1929–30.			
	Area: Feddans	*Crop: Kantars*	*Yield per Feddan*	*400-Lb. Bales*	*Area: Feddans*	*Crop: Kantars*	*Yield per Feddan*	*400-Lb. Bales*	*Area: Feddans*	*Crop: Kantars*	*Yield per Feddan*	*400-Lb. Bales*
Sakel:												
Gezira (syndicate)	105,587	347,972	3·29	82,644	131,391	466,169	3·55	110,716	158,585	336,411	2·12	79,897
,, (Kassala Cotton Company)	—	—	—	—	—	—	—	—	15,598	69,259	4·45	16,449
Tokar	45,000	53,454	1·19	12,695	50,000	46,606	0·93	11,069	45,000	54,615	1·21	12,971
Kassala (Gash Delta)... ...	25,840	65,568	2·54	15,572	28,537	71,007	2·49	16,864	55,456	83,016	1·50	19,716
Others	2,236	4,775	2·14	1,134	2,951	7,526	2·55	1,787	4,803	10,129	2·11	2,406
	178,663	471,769	2·64	112,045	212,879	591,308	2·78	140,436	279,442	553,430	1·98	131,439
American:												
Irrigated	13,572	41,492	3·06	9,440	17,863	55,132	3·09	12,542	17,641	50,376	2·85	11,208
Raingrown	38,648	20,354	0·53	4,630	43,280	37,620	0·87	8,558	58,680	67,962	1·16	15,122
Total	230,883	533,615	2·31	126,115	274,022	684,060	2·50	161,536	355,763	671,768	1·89	157,769

	1930–31.				1931–32.				1932–33.				1933–34.*			
	Area: Feddans	*Crop: Kantars*	*Yield per Feddan*	*400-Lb. Bales*	*Area: Feddans*	*Crop: Kantars*	*Yield per Feddan*	*400-Lb. Bales*	*Area: Feddans*	*Crop: Kantars*	*Yield per Feddan*	*400-Lb. Bales*	*Area: Feddans*	*Crop: Kantars*	*Yield per Feddan*	*400-Lb. Bales*
Sakel:																
Gezira (syndicate)	175,418	227,781	1·30	54,098	174,788	705,686	4·04	167,600	175,792	336,322	1·91	79,876	155,936	No Estimate.		
,, (Kassala Cotton Company)	20,605	38,562	1·87	9,158	19,191	99,365	5·18	23,599	19,183	39,154	2·04	9,299	18,991			
Tokar	60,000	68,299	1·14	16,221	38,000	52,614	1·38	12,495	40,000	95,513	2·39	22,684	37,700	59,000	1·33	11,875
Kassala (Gash Delta)	37,938	57,367	1·51	13,625	17,500	30,614	1·75	7,270	19,147	27,120	1·42	6,441	31,146	42,000	1·35	9,975
Others	3,502	6,993	2·00	1,661	3,591	15,513	4·32	3,683	3,956	11,057	2·79	2,626	5,447	18,400	3·38	4,370
	297,463	399,002	1·34	94,763	253,070	903,792	3·57	214,647	258,078	509,166	1·97	120,926	249,220	—	—	—
American:																
Irrigated	15,225	51,556	3·39	11,471	10,653	43,670	4·10	9,825	11,635	39,569	3·40	8,903	12,110	53,050	4·38	11,936
Raingrown... ...	60,363	63,263	1·05	14,076	59,840	46,640	0·78	10,492	43,225	33,565	0·78	7,553	59,414	87,077	1·47	19,592
Total	373,051	513,821	1·37	120,310	323,563	994,102	3·07	234,964	312,938	582,300	1·86	137.382	320,744			

* January Estimate.

INDIAN CROP.

(000's *Omitted.*)

	1928–9.	1929–30.	1930–31.	1931–32.	1932–33.	1933–34.
Area (acres)	27,053	25,922	23,812	23,722	22,558	23,561
Crop (Government estimate) 400-lb. bales	5,782	5,243	5,226	4,025	4,516	4,633
Average yield per acre (lbs.)	85	81	88	68	80	79
Staple $\frac{7}{8}$ and above (bales)	2,190	1,807	1,795	1,734	1,777	—
Per Cent. of Total ...	*37·9*	*34·5*	*34·4*	*43·1*	*39·3*	—
Staple below $\frac{7}{8}$ (bales) ...	3,592	3,436	3,429	2,291	2,739	—
Per Cent. of Total ...	*62·1*	*65·5*	*65·6*	*56·9*	*60·7*	—
Commercial Crop :						
New exports (bales) ...	3,933	3,868	3,729	1,582	—	—
Mill consumption ...	1,992	2,373	2,271	2,346	—	—
Domestic consumption ...	750	750	750	750	—	—
Total	6,675	6,991	6,750	4,678	—	—
Per cent. on Government estimate	+15·4	+33·3	+29·2	+16·2	—	—
Season's average spot price (Liverpool—pence per lb.)	8·03	6·39	4·02	4·32	4·84	—
Per cent. on American ...	76·3	70·3	70·4	89·6	86·1	—

WORLD'S CONSUMPTION OF COTTON.

FROM THE STATISTICS OF THE NEW YORK COTTON EXCHANGE SERVICE (GARSIDE).

(*Running Bales* 000's—*Outside Growths in* 500-*lb. Bales.*)

1932–33.	*American.*						*Outside Growths.*	*All Kinds.*
	U.S.A.	*U.K.*	*Continent.*	*Orient.*	*Others.*	*Total.*		
August	395	87	286	283	16	1,067	743	1,810
September ...	482	78	321	268	19	1,168	781	1,949
October	489	116	333	248	19	1,205	862	2,067
November ...	491	110	349	230	20	1,200	849	2,049
December ...	431	130	342	224	18	1,145	908	2,053
January ...	463	145	358			1,192	885	2,077
1st Half Season	2,749	666	1,989			6,977	5,028	12,005
,, *Federation* ...	*2,749*	*665*	*1,862*	*1,445*	*126*	*6,847*	*5,035*	*11,882*
2nd Half Season	3,255	699	2,090			7,428	5,207	12,635
,, *Federation* ...	*3,255*	*735*	*1,974*	*1,210*	*150*	*7,324*	*5,147*	*12,471*
Season's Total	6,004	1,365	4,079	2,721	236	14,405	10,235	24,640
1933–34.*								
August	572	117	343	202	28	1,262	913	2,175
September ...	487	127	340	211	28	1,196	892	2,088
October	490	135	353	221	24	1,215	913	2,128
November ...	463	140	350	230	23	1,206	924	2,130
December ...	340	117	344	237	21	1,059	909	1,968
January ...	494					1,107	1,071	2,178
1st Half Season	2,847					7,045	5,622	12,667
,, *Federation* ...	*2,847*	*771*	*2,086*	*1,148*	*166*	*7,018*	*5,501*	*12,519*

Subject to revision.

U.S. CONSUMPTION OF COTTON BY VARIETIES.

(Running Bales 000's: "Foreign" in Equivalent 500-lb. Bales.)

1932–33.	*Total.*	*Daily Rate.*	*Upland.*	*American Egyptian.*	*Egyptian.*	*Other Foreign.*	*Linters not Included.*
August ...	404·5	16·2	393·3	1·6	6·4	3·2	48·4
September ...	492·7	20·7	480·0	1·8	6·3	4·6	65·5
October ...	502·2	21·6	488·2	1·6	7·9	4·6	58·0
November ...	503·7	21·4	490·0	2·1	7·9	3·8	52·3
December ...	440·1	20·0	429·0	1·7	6·6	2·7	44·3
January ...	471·2	19·8	461·5	1·1	6·0	2·6	48·4
February ...	441·7	20·3	432·2	1·9	6·3	2·1	46·5
March ...	494·2	19·8	482·6	2·0	7·2	3·2	50·1
April ...	470·7	21·2	460·0	1·2	6·2	3·3	54·7
May ...	620·9	25·1	606·5	1·1	9·3	4·0	76·1
June ...	696·5	29·0	681·0	1·6	9·0	4·9	81·5
July ...	600·1	26·7	583·9	1·5	9·7	5·1	90·5
1933–34.							
August ...	588·6	25·6	571·3	1·2	11·3	4·8	83·3
September ...	499·5	24·1	485·7	0·9	9·2	3·8	76·5
October ...	503·9	23·2	489·0	1·1	9·6	4·2	66·8
November ...	475·4	22·1	461·8	0·9	9·0	3·6	59·1
December ...	348·4	19·4	338·9	1·1	6·2	2·2	51·6
January ...	508·0	22·3	493·8	1·1	10·2	2·9	57·8
February ...	478·0	24·2					

WORLD'S CARRYOVER OF *AMERICAN* COTTON.

(Running Bales 000's, excluding Linters in U.S.A.)

End of	*Stock and Afloat.*			*U.S.A.*		*Monthly Totals.*	*Federation. Other Mill Stocks.*	*Half-Yearly Totals.*	*Elsewhere in U.S.A.* *
	U.K.	*Continent.*	*Orient.*	*Mill Stocks.*	*Public Warehouses.*				
1929, July ...	442	563	—	932	923	2,860	1,197	4,332	275
1930, January ...	618	1,198	448	1,730	5,343	9,337	1,007	10,344	—
July ...	304	544	143	1,048	2,803	4,842	937	6,249	470
1931, January ...	644	1,198	343	1,523	7,895	11,603	907	12,510	—
July ...	436	766	401	922	4,491	7,016	950	8,816	850
1932, January ...	506	938	805	1,583	10,019	13,851	1,193	15,044	—
July ...	415	729	695	1,163	6,657	9,659	1,379	12,798	1,760
1933, January ...	620	1,189	852	1,455	9,982	14,098	1,248	15,346	—
July ...	536	1,058	616	1,298	5,703	9,211	1,259	11,550	1,080
August ...	542	957	555	1,113	5,764	8,931	—	—	—
September	554	1,056	604	1,115	7,347	10,676	—	—	—
October ...	549	1,224	701	1,315	9,452	13,241	—	—	—
November	593	1,340	818	1,526	10,387	14,664	—	—	—
December	648	1,364	776	1,596	10,288	14,672	—	—	—
1934, January ...	617	1,367	752	1,553	9,474	13,763	1,280	15,043	
February	614	1,325	730						

Included in Total.

HIGHEST AND LOWEST FUTURES PRICES.

1932–33.	American.				Egyptian (Liverpool).			
	New York.		Liverpool.		Sakel.		Uppers.	
	High.	Low.	High.	Low.	High.	Low.	High.	Low.
August ...	9·48	5·80	6·90	*4·40*	9·15	6·84	8·14	5·87
September	9·44	6·82	*7·00*	5·24	*9·52*	7·92	*8·35*	6·87
October ...	7·32	6·10	5·64	5·03	8·30	7·33	7·18	6·70
November	6·66	5·67	5·41	5·04	7·85	6·98	7·08	6·58
December	6·20	*5·53*	5·12	4·75	7·13	6·54	6·64	6·05
January ...	6·43	5·92	5·14	4·76	7·39	6·77	6·76	6·30
February	6·30	5·85	4·89	4·61	7·08	6·67	6·38	6·01
March ...	6·97	5·93	5·17	4·50	7·16	*6·45*	6·39	*5·80*
April ...	7·90	6·41	5·31	4·82	7·28	6·84	6·53	6·02
May ...	9·42	8·03	6·19	5·37	8·28	7·24	7·34	6·55
June ...	10·75	9·10	6·39	5·81	8·37	7·95	7·37	6·97
July ...	*12·00*	9·58	6·34	5·75	8·31	7·86	7·44	6·95
1933–34.								
August ...	10·66	*8·47*	6·12	5·22	8·02	7·00	7·21	6·33
September	10·71	8·94	5·58	5·15	7·34	6·84	6·46	6·01
October ...	10·08	8·83	5·47	5·15	7·21	6·79	6·26	5·91
November	10·30	9·41	5·29	*4·78*	7·08	*6·52*	5·99	*5·44*
December	10·29	9·96	5·20	4·96	7·55	6·78	5·99	5·67
January ...	11·49	10·30	5·93	5·19	8·42	7·57	6·58	5·99
February	*12·54*	11·53	*6·48*	5·92	*9·25*	8·36	*7·23*	6·61

Maximum and minimum figures in each season are given in italics.

LIVERPOOL SPOT PRICES OF AMERICAN WITH OTHER VARIETIES AS PERCENTAGES (LAST FRIDAY OF EACH MONTH).

1932–33.	American (Middling). Pence per Lb.	Indian No. 1 Fine Oomra.	West African (Middling.)	Brazil Pernam (Fair).	East African (Good Fair).	Tanguis (Good).	Uppers (F.G.F.).	Sakel (F.G.F.)
August ...	6·45	89·1	100·8	101·6	115·5	119·4	119·4	135·7
September	5·73	87·3	101·7	101·7	119·2	126·2	124·1	145·7
October ...	5·62	88·8	101·8	101·8	119·6	125·8	127·4	138·8
November	5·44	89·7	100·0	101·8	120·2	125·7	129·2	139·0
December	5·29	89·4	100·0	101·9	119·8	125·5	131·4	137·4
January ...	5·15	89·5	100·0	101·9	117·5	125·2	128·9	139·4
February	4·95	89·5	101·0	103·0	119·2	126·3	129·5	141·8
March ...	5·15	80·0	100·0	101·9	117·5	126·2	124·3	137·9
April ...	5·53	80·7	100·0	101·8	119·9	124·4	121·2	134·7
May ...	6·07	80·1	100·0	101·6	114·8	122·2	120·4	134·6
June ...	6·38	80·6	100·0	101·6	114·1	121·2	116·9	131·2
July ...	6·47	81·0	101·5	101·5	113·9	120·9	118·7	131·1
Season's average	*5·62*	*86·1*	*100·7*	*102·0*	*117·4*	*124·2*	*124·7*	*138·6*
1933–34.								
August ...	5·53	79·6	101·3	103·1	115·7	124·8	122·4	136·0
September	5·60	80·7	100·9	103·6	114·3	124·1	114·6	132·0
October ...	5·54	78·3	100·0	102·7	113·5	122·6	111·0	127·4
November	5·09	77·6	100·0	102·9	114·7	120·6	112·6	137·7
December	5·33	75·6	100·0	100·9	114·1	124·4	113·5	145·2
January ...	6·07	74·0	99·2	99·2	111·5	120·6	109·9	140·4
February	6·67	73·2	98.5	97.8	107·5	118·0	107·9	136·6

NOTES ON CURRENT LITERATURE

COTTON IN INDIA.

169. The following reports have recently been received:

Indian Merchants' Chamber. Ann. Rpt., 1932.
MADRAS: Rpt. of Operations of Dpt. of Agr., 1932-33.

170. INDIAN CENTRAL COTTON COMMITTEE. We have received from the Publicity Officer the following notices:

The Institute of Plant Industry, Indore. The reasons leading to the formation of the Institute in 1924 are outlined, and a summary is given of the work accomplished to date in the improvement of raw cotton in India. A very important achievement of the Institute has been the standardizing of a process—known as the Indore Compost Process—for rapidly converting farm wastes into a valuable organic compost manure at a small cost.

Heat Treatment Measures to Control Pink Bollworm in United Provinces. Summarizes the results obtained by the United Provinces Entomological Scheme, initiated in 1923, to determine the most suitable measures of control for the pink bollworm. Heat treatment of seed to 140° F. proved the most effective method. Proposals to extend the scheme for a further period are under consideration.

Improvement of Cotton in the Punjab. Briefly discusses the work carried out since 1925 at the Cotton Research Station, Lyallpur, on the improvement of Desi and American cottons. The work is financed by the Indian Central Cotton Committee and the Punjab Government.

Damage Caused to the Punjab Cotton Crop by White-Fly. Gives the results of an investigation, financed by the Indian Central Cotton Committee in 1931, to determine the nature and extent of the injury caused by white-fly, and to devise measures of control.

Object of the Pink Bollworm Scheme. Summarizes the results obtained from the scheme sanctioned by the Indian Central Cotton Committee in 1926 to study the incidence and distribution of pink bollworm in the Punjab, and also to ascertain reasons for the difference in incidence in the various parts of the Province.

Importance of Punjab Root-Rot Scheme. Deals with the scheme, financed by the Indian Central Cotton Committee for three years, to discover the cause of root-rot and suggest methods for its control.

Defibrating and Delinting Cotton at Lyallpur. Discusses the installation of a defibrating and a delinting machine at Khanewal, Punjab, to enable the thick fuzz on the seed of new types of long staple cotton to be removed, and thus increase its commercial value.

The Cotton Leaf-Hopper in the Punjab. Deals briefly with the life history, symptoms of attack, and control measures advocated.

Bikanir Gang Canal Scheme. A scheme financed by the Indian Central Cotton Committee with the view of obtaining by selection or hybridization improved types of Indian and American cottons capable of spinning at least 25's counts. Other problems under study are the best rotation crops for cotton and the correct adjustment of irrigation water.

171. IMPROVING THE INDIAN COTTONS. By R. D. Mihra. (*Text. Weekly,* xii., 294, 1933, p. 195.) Describes the work that is being carried out by the Indian Central Cotton Committee in co-operation with the Government of H.E.H. the Nizam of Hyderabad, with a view to evolving a strain of Gaorani cotton of a higher yield and ginning outturn than the present strain. The most promising

type is Gaorani 4, which is jassid resistant and very little susceptible to dry rot. The ginning outturn is higher than that of the parent variety, and experiments for the further improvement of this are in progress. Other promising strains are Gaorani 6 and 44, and comparative yield trials with these are being carried out. It is hoped that the experiments will enable Hyderabad, the home of Gaorani, to develop a strain which will be in good demand.

172. SIND AND THE LLOYD BARRAGE. No. II. (6th Edition. Printed at the Govt. Cent. Press, Bombay, 1933. Price: Re.1 Anna 1, or 1s. 10d.) This edition, revised to September, 1933, includes all the important changes effected during the last five years, and the subject-matter has been brought up to date for future reference. The work on cotton is reviewed under the following heads: The present position with regard to cotton improvement; the Indian Central Cotton Committee and the extension of improved varieties of cotton in Sind; the Sind Cotton Committee; trade exhibition of improved cottons in Karachi; botanical and agronomical investigations; physiological investigations on the cotton crop; cotton extension work in the barrage areas; future lines of work on cotton improvement.

173. A SHORT NOTE ON A NEW AMERICAN COTTON, N.T.1. By M. Afzal. (*Seasonal Notes*, i., **11**, Punjab Agr. Dpt., 1933. From *Plant Breeding Abstracts*, iv., **2**, 1934, p. 112.) This improved variety, N.T. 1, a bulk selection made in 1926 from 280 F, is described, and the results of comparative trials are given.

174. INDIAN COTTONS AND LANCASHIRE. CAN THEY BENEFIT THE INDUSTRY ? By Dr. A. J. Turner. (*Text. Weekly*, xii., **300**, 1933, p. 372.) Discusses the value of short-stapled Indian cotton for hosiery yarns; the attempts made during the present century to introduce long-staple cottons into India; the work of the Indian Central Cotton Committee, and the production of cotton in the various Provinces.

175. CAN WE USE MORE EAST INDIAN COTTON ? By W. H. Goodman. (*Coml. Oldham*, vii., **10**, 1933, p. 5.) The author states that one of the chief difficulties in the way of increasing the use of Indian cotton in Lancashire is the fact that most of the cotton available for export is of very short staple. The average Lancashire mill wishing to change on to Indian cotton from American would have to re-equip with rollers which could draw the shorter fibre, and this expense few mills could afford to incur at the present time.

176. BOMBAY. *Improved Production and Marketing.* (*Text. Rec.*, li., **610**, 1934, p. 65.) The Bombay mills propose to adjust their selling methods in order that selling should in all cases be done by the piece, on the basis of the texture, finish, design, and colour of the goods. It is also proposed to stop imitation or infringement of marks, numbers, designs, etc. Production is to be improved by concentrating on more profitable styles of textiles.

177. BOMBAY COTTON ANNUAL, 1932-33, No. 14. (East Ind. Cott. Assoc., Ltd., Bombay. Price Rs. 2.) The usual authoritative compendium of all matters relating to the cotton trade. It contains statistical tables of Crops, Exports, Imports, Prices, Stocks, Consumption, Government Notifications, etc., that should meet the requirements of all interested in the production, distribution, and consumption of Indian and foreign cottons, yarn, and cloth.

178. MADRAS. *Cotton Cultivation*, 1932-33. (*Rpt. on Operations of Dpt. of Agr., Madras*, 1932-33.) The main work of the cotton section was concerned with the production of better varieties of cotton suited to the different localities. In yield tests with Cambodia cottons, the three strains, Nos. 920, 1267, and 1742, for the first time proved superior to Co. 2. At Nandyal Station, Nos. 29 and 15 cottons, which gave the highest yield last season, proved only equal to N. 14 during the

present season. 111,153 lb. of N. 14 seed were distributed to the ryots. At Hagar Station the improvement of the local "Hingari" cotton by pure line selection was continued.

The Cotton Ginning Act and the Cotton Transport Act continued to function during the season. The Cotton Control Act, passed at the close of last year, prohibits the cultivation and mixing of pulichai (*G. neglectum*) cotton and its sale. A Bill to provide for the establishment and better regulation of markets for cotton in the Madras Presidency was also passed by the Legislative Council.

COTTON IN THE EMPIRE (EXCLUDING INDIA).

179. The following reports have recently been received:

Dept. of Scientific and Industrial Research: Rpt. for 1932-33.
Imperial College of Science and Technology: Ann. Rpt. to July 31, 1933.
FIJI: Ann. Rpt. of the Dpt. of Agr., 1933.
GOLD COAST: Rpt. of Dpt. of Agr., 1931-32.
NIGERIA: Rpt. of Dpt. of Agr., 1932.
NYASALAND: Ann. Rpt. of Dpt. of Agr., 1932.
QUEENSLAND: Ann. Rpt. of Dpt. of Agr. and Stock, 1932-33.
SOUTH AFRICA: Farming in S. Afr. Ann. Rpt. of Dpt. of Agr., 1932-33.
SUDAN: Rpt. of Finances, Admin. and Conditions of Sudan in 1932.

180. REPORTS RECEIVED FROM EXPERIMENT STATIONS, 1932-33. (Published by the Empire Cotton Growing Corporation, 1934. Price 2s. 6d. post free.) In accordance with the rotary scheme, the full reports this year come from South Africa (including Barberton, Natal, and Swaziland), Queensland, and St. Vincent, while summaries are included of the work of the other stations. As in former years, the chief points of interest in the volume are briefly outlined in the preface.

In connection with the extensive breeding work that is going on—perhaps the most important work at the present time—it is gratifying to note the continued success of U. 4 and its derivatives in South Africa and the colonies north of it. Details of breeding experiments with other promising strains of cotton are also included in the reports, and much useful work is described dealing with rotation of crops, spacing, manuring, and time of planting experiments, and the control of pests and diseases. The necessity for a closer study of insect pests of cotton in relation to their host plants has led to the establishment of a special section at the Barberton Station to deal with the subject.

The reports should prove of much interest and use to all those concerned with the breeding and cultivation of cotton and similar crops.

181. REPORT OF DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH, 1932-33. (Cmd. 4483. Pubd. H.M. Stat. Off., 1934. Price 3s. net.) The eighteenth annual report contains a general review of the work carried out under the supervision of the Boards and Committees of the Department, together with a summary review of the work of the various research organizations.

At the British Cotton Industry Research Association the investigation of the general problem of opening and cleaning cotton was continued with very satisfactory results. An entirely new method of separating the wanted fibre from the unwanted dust and trash has been evolved, and a new testing machine, known as the Shirley Analyzer for Raw Cotton or Waste, is now on the market. The invention has been protected in Great Britain and the chief cotton-using countries.

[*Cf.* Abstr. 17, Vol. XI., of this Review.]

182. AFRICA. GOLD COAST: *Manurial Trials.* (*Bull. No.* 24, Dpt. of Agr. Gold Coast, 1932, recently received.) In studies of the reasons for the very low yields of cotton obtained in the Northern Territories, farmyard manure was

applied to this crop in 1929 at Tamale Investigational Station, with the following results:

	Means of Four Replications (Pounds of Seed Cotton per Acre).	
	Allen Cotton.	*Ishan Cotton.*
No manure	74·8	64·4
Farmyard manure 11 tons per acre ...	154·0	143·6

The dressing applied was a very heavy one in order to make the test conclusive, and the cost is far higher than the value of the extra seed-cotton (about 80 lb.) produced. The effects of farmyard manure are, however, usually felt for some years, and not merely for one year after use.

183. *Cotton in the Northern Territories and Togoland.* (*Rpt. of Dpt. of Agr.*, 1931-32, recently received.) During the past four years investigational and experimental work has been carried out at Kpeve and Tamale Stations. The work at Kpeve has consisted largely of selection of Ishan types of cotton with a view to increasing yields, and improving the type grown by the peasants. This work should be continued, since there is a good chance of developing an export industry in Togoland, owing to its proximity to rail and road facilities.

In regard to ginning facilities, past experience has shown that little value is placed by the farmer on facilities provided free, and the ginneries should, therefore, be paid for in part at least by the cotton growers. The plan for the establishment of a ginnery in Kpandu or Ve-Deme from funds raised from cotton farmers has for the time being failed owing to local political troubles, but it will be put into effect as soon as the political authorities deem it wise to do so.

At Tamale Station satisfactory results have been obtained with a type of American Upland cotton, D. 28, and the following table shows the yield of this new strain in 1931-32 as compared with other selections under trial:

Strain.	*Yield of Seed Cotton per Acre.*
D. 28 (in rotation)	260 lb.
D. 28 (no rotation)	204 ,,
Coconadas	189 ,,
Karunganni	83 ,,
T66/126	45 ,,
T66/4	11 ,,

One secret of success has been the breeding of a type that flowers in the dry season rather than during the rains.

Before the slump occurred in cotton prices, a yield of 200-300 lb. per acre would have been profitable, but at present prices no yield would be found profitable in Tamale because of the high transport and other costs. In view of the possibility of some revival in cotton prices, work towards still further improvement of the D. 28 strain and in evolving equally good strains of other cottons should be continued.

184. NYASALAND: *Transport.* (*Crown Colonist*, iii., **25**, 1933, p. 588.) The North Road is now completed and places Nyasaland on the direct north-to-south line of motor communication through Africa. The road is 300 miles shorter than the old route, and the surface is good.

185. *Cotton Cultivation*, 1932. (*Ann. Rpt. of Dpt. of Agr.*, 1932, recently received.) As a result of the discouragement of growers caused by low prices and the reduction of the number of markets, cotton cultivation was restricted to the Lower

Shire, Chikwawa, and the Lisungwe areas. The amount of seed issued was considerably less than that of the previous year, but the resulting crop was most satisfactory. This was due to a good season, propaganda in favour of early planting, more economical use of seed, and the replacement for the most part of Nyasaland Upland by U. 4 seed. There were encouraging signs of an increased interest in cotton despite low prices. The crop was again purchased by the British Cotton-Growing Association.

During the year the decision was taken to concentrate the important plant breeding and selection work of the Corporation at Domira Bay Station, which is situated in an area both rich and capable of development as a cotton-producing territory. In addition, it is situated close to railhead and to what will be the main port of call for the Lake Nyasa steamers. The Port Herald Station was handed over to Government in 1932, and Makwapala will likewise be handed over after the 1933-34 season.

Work in connection with yield trials, rotation of crops, interplanting, strain testing, varietal trials, was continued, and a study was commenced of the problems of mixed cropping.

186. South Africa: *Cotton Cultivation*, 1932-33. (*Farmg. in S. Afr.*, viii., **93**, 1933, p. 487.) From this report we quote the following: "During the season less cotton was grown, owing to the unprecedented drought and low prices prevailing at the time of planting In the past few months prices have increased materially, and though still low, are encouraging, and one can predict a big increase in the area to be planted, especially if weather conditions improve. Cotton growers are much more optimistic as to the future, and are taking renewed interest in the crop. The periodical droughts to which large areas of the country are subject are concentrating attention on this plant—where mealies and other crops failed, cotton grew and stood up to the trying conditions.

"From the point of view of selections for drought-resistance and earliness, the severe conditions prevailing during the season yielded an excellent opportunity of selecting plants. The records of these selections, as well as those of the progeny increases, have been completed, and good material is now on hand for the future. Research work in connection with the problems inseparable from crop production in the Union was continued at the Rustenburg and Barberton Experiment Stations. The officers of the Empire Cotton Growing Corporation are continuing and extending the excellent research they have undertaken. Their work is fully appreciated by the Government and the cotton growers.

"At the Kakamas experimental plots the work with cotton was continued, and yields of 6,000 lb. of seed cotton per morgen were obtained under irrigation."

187. The South and East African Year Book and Guide for 1934. (Edited for the Union Castle Mail Steamship Co., Ltd., by A. Samler Brown and G. Gordon Brown.) We have received a copy of the 40th edition of this Year Book. Much useful information is first given about the voyage out to South Africa, the customs, scenery, hotel tariffs, native races, cost of living, education, history, climate, topography, openings for immigrants, etc., and then the individual States are considered in more detail, while some useful information is also included about the Belgian Congo and about Portuguese Africa. Labour, native policy, farming, live stock, irrigation, fisheries, locusts, mining, etc., are then considered, and a number of routes through the country are described in some detail, with figures as to population, rates, etc., for each important place. Similar information is also given for East Africa. The book is obviously one that should prove of much use to anyone visiting South or East Africa.

188. Uganda: *Cotton Reports*, 1932-33. (*Ann. Rpt. Dpt. of Agr., Uganda*, 1932, p. 11.) From the reports on cotton breeding it would appear that the standard

cotton, N. 17, in the Eastern Province is showing signs of deterioration, and other strains are being bred up to replace it. The Senior Botanist states that the local cotton in Buganda, although still giving good yields, has also deteriorated heavily in quality, and the problem of replacing this cotton in the near future has become a matter of considerable importance. In this connection, the selection known as S.G. 23.8 is putting up a good performance record in Buganda, and since the jassid is not of great importance in this area, it may prove to be desirable to introduce this strain into general cultivation. S.G. 23.8 is a low shedding strain with excellent spinning qualities. Several promising lines resistant to blackarm have also been isolated, and one promising U. 4 strain has reached the Pedigree Line stage. At Serere several U. 4 derivatives have proved higher yielders than the Nyasaland Upland type.

From the Mycologist's report we learn that progress is being made in elucidating the factors that enable an outbreak of blackarm disease to occur; two years ago this disease reduced the cotton crop by some 70,000 bales.

In the Entomologist's report it is stated that the pink bollworm has spread south to the Minakulu ginnery, and may reach Lango in the near future. The outstanding pest of the season was *Helopeltis*, which did considerable damage at Bukalasa, especially to early sown cotton. Other pests encountered were jassid, *Lygus vosseleri*, and stainers.

189. *Cotton Prospects*, 1933-34. The latest report from the Department of Agriculture states that weather conditions during December had improved the condition of the crop generally, and the later sowings in particular, and the grade of the crop would be above average. From the satisfactory condition of the crop it was estimated that a total production equivalent to 275,000 bales of 400 lb. would be reached.

190. AUSTRALASIA. QUEENSLAND: *Cotton Cultivation*, 1932-33. (*Ann. Rpt. of Dpt. of Agr. and Stock*, 1932-33.) The season in the cotton districts was not generally favourable for the production of profitable yields. With the exception of 500 bales shipped to England and 100 bales to Japan, the crop was purchased by Australian spinners. There was a considerable extension of acreage in the Callide Valley, where complete crop failure—due to the severest drought for sixty years—was the previous season's experience. The financial assistance afforded by the Government enabled settlers further to increase their holdings, and even with a comparatively short crop in prospect, it is estimated that from 60-66 per cent. of the loans advanced will be repaid this season. A succession of dry seasons has shown the remarkable drought-resistant properties of the cotton plant, and the yields obtained—when most other crops failed—indicate that cotton is worthy a place in the cropping system. The standard of cultivation showed improvement on that of the previous year. At the Cotton Research Station good progress was made in the development of improved Durango seed and in increasing supplies of the best strain of Acala cotton. The Lone Star variety continued to give satisfactory results in the Mundubbera district. Indio and Mebane cottons are considered to have decided possibilities for certain soil types, and 600 lb. of Indio and 3,000 lb. of Mebane seed have been imported from California and Texas for planting in the 1933-34 season. The worst cotton pest for the second year in succession was the rough bollworm (*Earias huegeli*, R.); other pests encountered were corn-ear worm (*Heliothis obsoleta*), pink bollworm, and the cutworm (*Euxoa radians*).

191. FIJI: *Cotton Industry*, (*Ann. Rpt. Dpt. of Agr. Fiji*, 1932.) The area devoted to cotton was considerably smaller than that for the two previous years, owing in part to the information regarding the probable continuance of low prices, issued a month before the planting season. Weather conditions were

unfavourable to the crop. Sea Island was the only variety planted, the total number of planters being 484, of whom 461 were Indians and 23 Fijians. The average yield per acre was lower than in former years, but the quality was better; this was attributed to the harvesting of fully matured good seed cotton only. Pink bollworm and boll-rot were more in evidence than usual. Owing to the poor demand for Sea Island cotton, it was decided to suspend commercial cotton-growing for one season.

The Fijian agricultural instructional scheme at Nadroga and Colo West continued on sound lines, while the expansion of experimental work at the Cotton Research Station proved of substantial value.

192. WEST INDIES. REPORT OF THE WEST INDIAN SEA ISLAND COTTON CONFERENCE, TRINIDAD, 1933. (Govt. Printg. Off. Port of Spain, 1933. Price 2s.) The Conference was the outcome of a decision taken at the Conference held in Barbados in 1932, to form a West Indian Sea Island Cotton Association, the main object of which would be to promote and protect the interests of the Sea Island cotton industry in the British West Indies, and to establish it on a sounder basis.

The report gives a detailed account of the proceedings. The Association has been constituted as a voluntary body financed by funds derived from a voluntary levy on the export of lint. The Commissioner of Agriculture has been elected as first President, and the Assistant to the Commissioner as Secretary and Treasurer. Subscribing membership is open to all organized Sea Island Cotton Growers' Associations in the British West Indies, and honorary membership to persons or bodies elected by the Executive Committee of the Association.

Among the matters dealt with at the Conference were: the control of production; the raising of a cess to meet the expenses of the Association; the formation of an Advisory Committee in England; the programme of work for 1934; legislation.

193. REPORT BY MR. F. A. STOCKDALE, C.M.G., C.B.E., AGRICULTURAL ADVISER TO THE SECRETARY OF STATE FOR THE COLONIES, ON HIS VISIT TO THE WEST INDIES, 1933. (C.A.C., 170.) An interesting report on a visit made to the West Indies to attend the West Indian Inter-Colonial Fruit and Vegetable Conference, the West Indian Sea Island Cotton Conference, and the meetings of the Central Cane-Breeding Station, Barbados. In connection with the cotton industry Mr. Stockdale states: " An improvement in the Sea Island cotton industry has aroused new hopes in the producers in those drier islands where this crop is the main stand-by, and if the improvement which has taken place in the demand for Montserrat cotton is maintained, there is every reason to believe that tomato-growing will again be deserted for cotton production, unless prices for tomatoes in Canada greatly advance."

COTTON IN EGYPT.

194. COTTON CULTIVATION, 1934. (*Int. Cott. Bull.*, xii., **46**, 1934, p. 192.) The report of the Missr Cotton Export Co. for January states that the acreage for 1934 would equal that of last season. The demand for Gizeh 7 has been extraordinary; nearly three times as much has been sold as at the same period last year. Sakel appears likely to be reduced, and will probably be confined more and more to the north of the Delta, where the finest Sakel is grown, and for which certain mills always have a demand.

195. EGYPTIAN COTTON BALES: MOISTURE CONTENT. By H. E. Ahmed Wahab Pasha. (*Int. Cott. Bull.*, xi., **44**, 1933. Abstr. from *Summ. of Curr. Lit.*, xiii., **21**, 1933, p. 551.) The agreement between spinners and exporters on the standard of moisture in Egyptian cotton will be continued up to September, 1936, and the

standard remains 8·5 per cent. regain, with an allowance of 0·4 per cent. up and down. Attention is drawn to the usefulness, accuracy, and inexpensiveness of the services of the official Testing House at Alexandria.

196. COTTON BAGGING IN PLACE OF JUTE FOR EGYPTIAN COTTON BALES. By A. S. Pearse. (*Int. Cott. Bull.*, xi., **44**, 1933, p. 671.) It is estimated that 80 per cent. of yarn breakages are due to the presence of jute fibres in the cotton. The jute fibres may come from the bags in which the cotton is packed and from the clothing of the pickers. The use of cotton bags instead of jute will not solve the difficulty until the latter is entirely prevented from coming into contact with the cotton in any stages of its manufacture. Cotton bags cost from 2s. 6d. to 3s. 7d. each, whilst a jute bag costs 1s. Experiments are in progress to test the behaviour of cotton packed in jute and in cotton bags.

197. EGYPTIAN COTTON: HAIR WEIGHT TARGET DIAGRAMS. By C. H. Brown *et al.* (*Min. Agr. Egypt. Tech. Sci. Serv. Bull. No.* 125, 1933. Abstr. from *Summ. of Curr. Litt.*, xiii., **22**, 1933, p. 592.) Target diagrams were prepared for four strains of Sakel and four of Ashmouni for hair-weight against seed-weight and halo length against hair-weight. Correlation exists between hair-weight and seed-weight, but not between hair-weight and halo length. Considerable range in hair-weights is shown by Ashmouni, but Giza 2 shows a type group within the same total range, indicating that this strain may be a semi-purified stock of a relatively coarse strain of Ashmouni. Giza 22 shows a similar range, but concentration is at a lower hair-weight. Giza 19 shows a smaller range, and will be substituted for Giza 2 as the nucleus stock of the Ashmouni Gedid variety. In the Sakel strains Sakha 7 appears slightly superior to Sakel Domains. Graphs of mercerized diameters show that higher hair-weights give coarser diameters, but no correlation between diameter and hair-weight has yet been found.

198. SAKELLARIDIS COTTON. (*Int. Cott. Bull.*, xii., **46**, 1934, p. 186.) The death occurred recently in Alexandria of M. Jean Sakellaridis, the originator of the famous strain of cotton which bears his name.

Early in the present century M. Sakellaridis discovered in a sack of Nubari cotton three bolls of exceptional quality. These produced fifteen seeds which he planted in his own garden, and as the result of careful attention obtained a good quantity of cotton of a quality previously unknown. He continued to plant the seeds, and in 1906 had sufficient to plant 50 feddans in twelve different places near the village of Rimali and three at Horein. The first 12 feddans produced 90 kantars of cotton, and the three others 24 kantars; no other variety of cotton planted in Egypt, until then, had given so excellent a yield.

COTTON IN THE UNITED STATES.

199. AMERICAN TEXTILE NOTES. By W. Whittam. (*Text. Rec.*, li., **609**, 1933, p. 65.) The Administrator of the Agricultural Adjustment Administration states that for the years 1934 and 1935 cotton acreage will be reduced from 40 million acres to 25 million acres.

At the eighth annual meeting of the Cotton Textile Institute, the President reported that as a result of the forty-hour week under the National Recovery Administration Code the number of workers in cotton mills had increased by 140,000, or 40 per cent., during the last week in August, as compared with the first week in March. Another speaker stated that the gain in weekly pay-rolls due to increased employment and higher wages was 111 per cent., and the average labour cost per unit of production for the industry as a whole 70 per cent. higher. He also estimated that the processing tax of 4·2 cents per lb. on raw cotton adds

30 per cent. to the current cost of cotton with $1\frac{3}{16}$ inch staple, and 45 per cent. to that of the shorter staples.

200. Cotton in U.S.A. (*U.S. Dpt. Agr. Yearbook*, 1933. Abstr. from *Exp. Sta. Rec.*, 69, **5**, 1933, p. 645.) Recent economic and technical developments in the cotton industry are reviewed in brief articles entitled, " American Cotton Holds Ground despite Growth of Foreign Competition " (L. Myers *et al*); " Multiplicity of Varieties Handicaps Improvement in the American Cotton Crop " (C. B. Doyle); " Live-at-Home Plans and Soil Building Aid Cotton Growers " (C. B. Doyle); " Fertilizer Composition and Placement Play Big Part in Cotton-Growing " (J. J. Skinner); " Cotton Diseases Take Two Million Bales of U.S. Crop Annually " (D. C. Neal); " Culture, Insecticides, and Quarantines Help Control Cotton Pests " (R. W. Harned); " One-Variety Community Plan shows Numerous Practical Advantages " (O. F. Cook and C. B. Doyle).

201. Cotton Year Book of the New York Cotton Exchange, 1933. The sixth edition, prepared as usual under the direction of Alston H. Garside, Economist of the Exchange, contains practically all of the series of statistics given in the previous Year Book, with considerable additional data. Statistics are given of American cotton and also of foreign growths. The tables have been compiled to present a complete picture of the world supply and world distribution of all kinds of cotton, together with data indicating economic factors which affect the world cotton trade and influence the market value of American and foreign cottons. The statistics of American cotton are all exclusive of linters, while those of foreign cottons are in uniform bale units.

202. Report of the Visit to U.S.A., 1933. By N. S. Pearse. (*Int. Cott. Bull.*, xii., **45**, 1933, p. 45.) The various sections of this report are concerned with the following matters: President Roosevelt's programme; the cotton adjustment plan; cotton acreage, 1934 and 1935; the cotton textile code; false packing; moisture in cotton; the 1933 cotton crop.

203. Comparative Advantages of Jute and Cotton Bagging for American Cotton Bales. By J. W. Wright and R. J. Cheatham. (*U.S. Dpt. Agr., Bur. Agr. Econ.*, 1933. Abstr. from *Exp. Sta. Rec.*, 69, **4**, 1933, p. 514.) The status of jute and cotton as bale-covering materials is reviewed, and the merits of the two materials are compared. Jute can withstand the rough handling which cotton bales receive, but it lacks durability, has excessive weight, and the presence of jute fibres in cotton causes spinning losses. Cotton bagging is durable, light, and contributes to neatness of the package. It is thought that the lower cost of jute bagging may be offset by the greater re-use value of cotton bagging, savings in freight and insurance and in cotton adhering to bagging, and increased consumption of cotton.

204. Georgia. *Farm Prices of Cotton Related to its Grade and Staple Length, Seasons* 1929-30 *and* 1930-31. By L. D. Howell and W. T. Fullilove. (*Ga. Sta. Bull.* 174, 1933. Abstr. from *Exp. Sta. Rec.*, 69, **4**, 1933, p. 605.) This study was made in co-operation with the Bureau of Agricultural Economics, U.S.D.A., to determine the variations in prices paid in the same local market for the same grades and staple lengths of cotton, and whether the average local market prices vary with the average grades and staple lengths sold; to compare the variations of local market prices with the premiums and discounts in central markets and the fluctuations of central market prices, and to examine the relationship between seasonal variations in price and in average grade and staple length. Data were collected from 10,664 bales sold in twelve local markets in 1929-30 and 8,492 bales sold in eleven markets in 1930-31. Much of the material is in the form of tables and charts.

205. Oklahoma. *A Study of Certain Economic Factors in Relation to Social Life among Cotton Farmers.* By O. D. Duncan and J. T. Sanders. (*Okla. Sta. Bull.* 211, 1933. Abstr. from *Exp. Sta. Rec.*, 69, **4**, 1933, p. 614.) Cotton farming in Oklahoma is closely related to a high percentage of non-owner farmers. Rural social problems are intimately tied up with the cotton situation. The greatest single obstacle to an improved standard of living is the high cost of running the farm in proportion to the total gross income received from it.

COTTON IN FOREIGN COUNTRIES.

206. Belgian Congo. *Transport.* (*Soir*, 10/1/34.) A branch of the local railway has been opened from Zobia to Mawa, a distance of 117 kilometres, serving a region well suited to cotton. It has been constructed in eight months, and brings the total of railways in Vicicongo to 587 kilometres. Costs of (ginned) cotton transport on the Kivu line have been fixed at 0·3575 francs for 10 kilometres for 10 kilogrammes, or roughly 4s. a bale for twenty-five miles.

207. Cotton Growing in Brazil. By J. M. Fernandes and L. Guimaraes. (*Apontamentos sobre o algodao*, Min. da Agr. Indus. e Comercio, Brazil. Abstr. from *Int. Rev. Agr.*, xxiv., **10**, 1933, T432.) The principal varieties of cotton grown are Moco, Inteiro, Verdao, Quebradinho, and Algodoi.

208. China's Four-Year Plan. By Chen Kung-Po, Minister of Industry. (*Anglo-Gujarati J.*, xxvi., **4**, 1933, p. 897.) In regard to cotton, it is stated that serious attention is being given to seed improvement at the various experiment stations. The question of transport costs is also being considered. Cotton grown in Shensi is sold locally at $12 per picul, but the price rises to $47 when quoted for delivery in Shanghai. Excessive freight charges account for this abnormal increase of nearly 300 per cent. in the selling price. Cotton mills are handicapped by such crippling costs, and are at the mercy of foreign competitors. With a view to lowering transport costs the Ministry of Industry has approached the Ministry of Railways for the formation of a joint cotton transport company, and it is hoped that this project will shortly materialize.

209. Cotton Industry and Trade in China, I., II. By H. D. Fong. (*Nankai Inst. Econ., Indus. Ser. Bull.* 4, 1932, Vols. I. and II. Abstr. from *Exp. Sta. Rec.*, 69, **4**, 1933, p. 606.) The several chapters of volume I describe and discuss the development and localization of the industry; the production, consumption, price movements, international trade in, and marketing methods for, raw cotton; the marketing and price movements of manufactured cotton; the extent and character of labour used; labour organizations, legislation, and welfare work; the technical and financial size of mills; hand-loom weaving; imports and exports of cotton goods; and the prospects for the industry. Vol. II. includes the statistical appendices.

210. Cotton: Cultivation in Eritrea. By R. Guidotto. (*Boll. Cotoniera*, **28**, 1933, p. 216. Abstr. from *J. of Text. Inst.*, xxiv., **12**, 1933, A603.) The cultivation of cotton by the natives in Eritrea is in a primitive state, and confined to tree varieties which give their greatest yields in the second year. The more advanced cultivators undertake some thinning, weeding, and pruning. At Tessenei an attempt is being made to extend and improve cotton cultivation. This year trials have been made with Sakellaridis and American varieties, but the crops have suffered from attack by *Bacterium malvacearum*, *Heliothrips indicus*, and *Earias biplaga*.

211. Association Cotonnière Coloniale. *Bull. No.* 12 contains the report of M. Hesling, Director-General, on the activities of the Association during 1932, and

the suggested programme of work for 1933. In addition, there are the following two articles: "Les voies de communication de la Côte d'Ivoire" and "La culture du coton au Togo." *Bull. No.* 13 contains the following articles: "Rapport sur la campagne cotonnière en Côte d'Ivoire" (Des Étages); "Prévisions pour la campagne cotonnière au Soudan et en Côte d'Ivoire"; "Note sur le cotonnier variété hybride Karangani × Garroh Hills, dit, improprement, Karangani No. 5" (Rochette), dealing with the vegetative characters, yield, resistance to disease and pests, length, fineness, and strength of the strain; "Les difficultés de l'industrie cotonnière Européenne" (Brasseur); "L'aménagement du Moyen-Niger" (Brissaud-Desmaillet). The usual notes on cotton in the French Colonies, cotton legislation, etc., are included in both bulletins.

212. JAPANESE COTTON GOODS: TRADE IN NEAR EAST. By R. Hagen. (*Wirtschaftsdienst,* **18,** 1933, p. 1613. From *J. Text. Inst.*, xxv., **1,** 1934, A54.) Tables included show a decrease in imports from Japan for most Near Eastern countries in 1932. The effect of high tariffs is discussed.

213. THE COTTON TRADE AND JAPAN. (*Man. Guar. Coml., Ann. Trade Rec.,* 27/1/34.) Discusses the effect of the depreciation of the yen.

214. PERU. *Cotton Industry,* 1933. (*Man. Guar. Coml.,* 13/1/34.) All the valleys in which cotton is grown show a considerable increase in production, with the valleys of Chincha and Piura leading with increases of 50 per cent. and 35 per cent. The total crop is estimated at some 270,000 bales of 480 lb. each, as compared with 231,055 bales in 1932.

215. THE CULTURE OF SEA ISLAND COTTON IN PUERTO RICO (trans. title). By J. P. Rodriguez. (*Puerto Rico Dpt. Agr. and Com. Sta. Circ.* 102, 1933. Abstr. from *Exp. Sta. Rec.*, 69, **5,** 1933, p. 646.) Cultural and field practices and irrigation and harvesting methods are described for growing Sea Island cotton in Puerto Rico. Information is also given on seed selection, control of insect pests and diseases, the cotton zones of the island, and statistics on production and commercial movement of the crop.

216. COTTON CULTIVATION IN NORTH KIRGIZ. By M. M. Gorjanskii *et al.* (*Bull. NIHI. Moscow and Tashkent,* 1933. From *Plant Breeding Abstracts,* iv., **1,** 1933, p. 64.) Comparisons in earliness, yield, etc., were made with some of the new numbers, sown direct and transplanted, and with Navrotskii as control. The transplanted cotton preceded the sown cotton by six to thirteen days in flowering, and eight to twenty-two days in maturity. Navrotskii was the best in yield and length of lint, closely followed by No. 1306.

SOILS AND MANURES.

217. FIELD OBSERVATION OF SOIL EROSION INDEX VARIANTS. By J. T. Copeland. (*Agr. Eng.*, 14, **8,** 1933. Abstr. from *Exp. Sta. Rec.*, 69, **6,** 1933, p. 874.) In a contribution from the Mississippi State College field observations are reported of the reaction of the many soil and crop variables, and their response to the soil erosion index method of determining terrace location, grade, and direction.

218. THE WASTE PRODUCTS OF AGRICULTURE: THEIR UTILIZATION AS HUMUS. By A. Howard. (*J. of Roy. Soc. Arts.*, lxxxii., **4229,** 1933.) In this lecture Mr. Howard discusses the relation between man-power and cultivated area in India; the rôle of humus in soil fertility; the manufacture of humus by the Indore method; some practical applications of the process; the conversion of municipal and village

wastes into humus; future developments. The lecture, which was well illustrated, should be read by all those interested in the improvement of tropical soils. [*Cf.* Abstr. **43**, Vol. IX. of this Review.]

219. USE OF THE EXPONENTIAL YIELD CURVE IN FERTILIZER EXPERIMENTS. By W. J. Spillman. (*U.S. Dpt. Agr., Tech. Bull.* 348, 1933. Abstr. from *Exp. Sta. Rec.*, 69, **3**, 1933, p. 339.) The author discusses a graphic method, a logarithmic method, and a new method which makes possible the determination of the most probable value of the constants by the method of least squares. The application of the exponential yield curve to a specific case in which each of the three common plant-food elements is varied, including the method of passing from the 1-variable form to the general form of the equation, is shown; a method for determining the quantity, if any, of each of the three common plant-food elements absorbed by the soil, and held in a condition unavailable to the growing crop, is presented; the form of the yield curve is discussed, with a presentation of reasons given for preferring the exponential to the parabolic form; and the derivation of all the commonly employed forms of the exponential yield curve is presented. Also, formulas for determining for specific cases the optimum fertilizer formula to use, the optimum quantity of fertilizer to apply for greatest profit per acre, and for determining the optimum formula to use, and the optimum acreage to which to apply a fixed quantity (value) of fertilizer for greater profit per dollar invested in fertilizer, in both presence and absence of the phenomenon of plant-food occlusion by the soil, are worked out; plans for obtaining from a relatively small number of experimental plants the data necessary for determining the constants in the exponential yield equations are outlined; and the manner of utilizing check plats as a means of eliminating, in so far as this can be done, unevenness in the yielding power of the soil of the experimental field is discussed.

220. THE EFFECT OF A SOIL MULCH ON SOIL TEMPERATURE. By E. S. West. (*J. Coun. Sci. and Indus. Res.* (*Aust.*), v., **4**, 1932, p. 236. Abstr. from *Exp. Sta. Rec.*, 69, **3**, 1933, p. 339.) The layer of soil at the surface loosened by cultivation has a lower heat diffusivity than the compact soil. In the case investigated, the heat diffusivity was reduced to 0·17 of that of the original compact soil. This resulted in the soil temperature wave of cultivated soil being markedly damped as compared with that of the uncultivated soil for any specific depth below the cultivated layer. In the cultivated layer itself, the temperature wave at the surface had a greater amplitude than the temperature wave at the surface of undisturbed soil, but at the bottom of the cultivated layer the amplitude was much less in the cultivated soil than at a similar depth in the uncultivated soil. The mean temperature during the summer months, down to a depth of 60 cm., was about 2° C. lower in the cultivated soil than in the undisturbed soil.

221. COTTON FERTILIZERS: MECHANICAL APPLICATION. By G. A. Cumings *et al.* (*U.S. Dpt. of Agr. Circ. No.* 264, 1933. Abstr. from *J. of Text. Inst.*, xxiv., **12**, 1933, A607.) Under the conditions prevailing in 1931, applications of 800 lb. per acre of a compound fertilizer (known as 4-8-4), drilled either in bands 1½ or more inches to each side, or 4 inches directly below the seed, had no apparent injurious effects on germination. On sandy clay loam the appearance of seedlings was greatly delayed, and the final stand was seriously reduced only when all the fertilizer was placed in contact with the seed, but on the coarse sand and Norfolk very fine sandy loam this occurred also when the fertilizer was placed below the seed, either in bands at depths of 3 inches or less, or when mixed with the soil and when one-eighth or one-fourth of the fertilizer was placed in contact with the seed. Seedlings came up most rapidly when the method of application produced a soil solution in contact with the seed containing from 0·05 to 0·02 per cent. of soluble salts. Various machines for drilling-in fertilizers are illustrated.

222. COTTON SEEDLINGS: MANURING. By J. W. Tidmore. (*J. Amer. Soc. Agron.*, **25**, 1933, p. 619. Abstr. from *Summ. of Curr. Lit.*, xiv., **1**, 1934, p. 1.) Ammonia in solutions as dilute as 19·6 parts per million was injurious to cotton seedlings, but the equivalent amount of calcium nitrate was harmless. Acid phosphate concentration of the nutrient solution must be very high to prevent injury by ammonia.

223. NITROGEN BALANCE IN BLACK COTTON SOILS IN THE MALWA PLATEAU. By Y. D. Wad and V. G. Panse. (*Ind. J. Agr. Sci.*, iii., **5**, 1933, p. 820.) *Summary.*—Higher yields of cotton from dressings of safflower cake have been shown to be due not so much to improvement in soil tilth, but to appropriate supply of nitrogen. A suitable method of studying nitrification in soil is described. In black cotton soil the concentration of free nitrates is found to be very low under the conditions of the experiment. Algæ are shown to be an important factor in conservation of nitrates. The possibilities of the absence of appreciable leaching and denitrification in arable soils is discussed.

CULTIVATION, IRRIGATION, GINNING, USE OF SEED, ETC.

224. BUDDING AND GRAFTING TRIALS WITH COTTON AND RELATED PLANTS. By R. E. Beckett. (*U.S. Dpt. Agr. Circ.* No. 267 (1933). Abstr. from *Exp. Sta. Rec.*, 69, **5**, 1933, p. 645.) In budding and grafting trials near Bard, California, widely different species of *Gossypium* were united successfully by these methods, and related genera also could be budded and grafted with species of *Gossypium*. *G. sturti* was budded successfully on *G. davidsoni* and *G. arboreum*, and inarched with Upland types of cotton from Lower California and Siam. *Thurberia thespesioides* was budded on *G. arboreum* and *G. calycotum*. *Paritium tiliaceum* was inarched with *G. davidsoni*, *Gossypium* species of Upland cotton from Mexico, and *Thurberia thespesioides*. *Thespesia populnea* was inarched with *G. sturti* and *G. morrilli*, and *Eriozylum aridum* was budded on *G. arboreum*. Eight of 21 budding trials and 11 of 15 inarch grafts were successful.

225. COTTON ROOTS: DEVELOPMENT. By J. W. Hubbard and F. W. Herbert. (*U.S. Dpt. of Agr. Circ. No.* 262, 1933. Abstr. from *J. of Text. Inst.*, xxiv, **12**, 1933, A607.) Observations of cotton-root development made in California in 1929 and 1930 show that cotton seedlings establish deep root systems promptly, so that it is seldom necessary to irrigate until a long period after planting. Plants 8 to 10 inches in height may have tap roots extending 4 to 5 feet below the surface of the ground. Streaks of coarse sand cause the roots to wither on penetration. Early irrigation develops large lateral roots near the surface, whereas the withholding of water supplies causes deep penetration of the roots, and affords more constant conditions for plant growth.

226. GROUNDNUT AS A ROTATION CROP WITH COTTON. By D. N. Mahta and D. L. Janoria. (*Ind. J. Agr. Sci.*, iii., **5**, 1933, p. 917.) An account of rotation experiments carried out during the past nine years in Berar. The results indicate that a three-course rotation of cotton, *juar*, and groundnut is the most suitable one for the black cotton soil of Berar, and will go a long way towards solving the problem of the low yield of cotton in the province.

227. COTTON BOLLS: ARTIFICIAL RIPENING. By S. N. Schatz. (*Russ. P.* 22,387 of 10/10/29 and 27,539 of 22/12/30. Abstr. from *J. of Text. Inst.*, xxv., **1**, 1934, A4.) Fruits of cotton, flax, hemp, etc., are gathered before ripening, and this process is hastened by exposing them to the action of ethylene at the ordinary or raised temperature.

228. Effects of Varying Amounts of Potash on Oil and Protein and on the Weight and Percentage of Cotton Seed. By J. F. O'Kelly *et al.* (*Miss. Sta. Tech. Bull.* 20, 1933. Abstr. from *Exp. Sta. Rec.*, 69, 4, 1933, p. 514.) Seed cotton grown in fertilizer tests at the station and at the Raymond and Poplarville Substations, and in simple side-dressing trials involving potash salts, was examined for oil and protein content, seed size, and lint percentage.

Application of fertilizer containing nitrogen and phosphorus alone resulted in a decrease in oil content as compared with the oil content of seed produced without fertilizer. Addition of potash to the fertilizer increased the oil content, and usually each successive potash increment produced a corresponding increase in the oil per ton of seed, especially where such increments increased yields of seed cotton. On the other hand, nitrogen and phosphorus without potash increased the protein content above that produced without fertilizer. Potash increments added to the mixture decreased the protein content, but not always in direct proportion to the amount applied. Yields of seed cotton were increased more than enough to offset this depressing effect of potash on the protein content, and more protein per acre was produced where potash was used than where it was omitted. In general, potash tended to increase the weight of the seed and to decrease the seed percentage, but probably not to a significant extent.

PESTS, DISEASES, AND INJURIES, AND THEIR CONTROL.

229. Note sur *Argyroploce leucotreta*, Meyr. By H. J. Bredo. (*Bull. Agr., Congo belge*, xxiv., 2, Brussels, 1933. Abstr. from *Rev. App. Ent.*, xxi., Ser. A, 12, 1933, p. 684.) *Argyroploce leucotreta*, Meyr., which has been known for 30 years as a pest of citrus in South Africa, has become widely distributed and injurious to cotton in the Belgian Congo. All stages are described, and the characters distinguishing it from *Platyedra gossypiella*, Saund., with which it has been sometimes confused, are given. The eggs are laid singly, generally at a slight distance from each other. In the Belgian Congo there are not many annual generations of this Tortricid; in cotton fields, where it had been abundant in July, it had practically vanished by the end of September. The injury to cotton is similar to that caused by pink bollworm. The larva enters the boll through a small entrance hole and attacks all the seeds in the first locule before passing into the next, sometimes ultimately destroying them all. The empty pupa case is usually found on the surface of the boll, whereas that of pink bollworm is generally inside the seeds where pupation has taken place. The comparative percentage of injury to cotton caused by *A. leucotreta* and other cotton pests in Nigeria in 1925 is quoted, and its relative importance among pests of cotton in different localities in the Belgian Congo is indicated. It was mainly responsible for halving the yield of one plantation that had produced 282 tons the previous year. Parasitism to the extent of 10 to 15 per cent. by a Braconid, *Chelonus* sp., was sometimes observed.

230. Irregularity among Cotton Plants in Time of Fruiting as a Factor Affecting Susceptibility to Damage by the Cotton Boll Weevil. By P. W. Calhoun. (*J. Econ. Ent.*, 26, 6, 1933, p. 1125.) Considerable irregularity seems to exist among cotton plants as regards earliness of fruiting. Using the time of appearance of the first blossom on each plant as the criterion, the frequency distribution for 600 plants approximated a normal curve, the maximum for the frequency histogram occurring on the eleventh day. It is suggested that such lack of uniformity in time of fruiting perhaps contributes to increased susceptibility of cotton to damage by the boll weevil (*Anthonomus grandis*, Boh.).

231. Ingestion of Poison by the Boll Weevil. By H. J. Reinhard and F. L. Thomas. (*Bull. Texas Agr. Exp. Sta. No.* 475, 1933. Abstr. from *Rev. App.*

Ent., xxi., Ser. A, **11**, 1933, p. 587.) Previous attempts to control the boll weevil (*Anthonomus grandis*, Boh.) by means of various arsenicals are reviewed, and experiments on the ingestion of calcium arsenate by the weevil are described.

232. INDIA: UNITED PROVINCES. *Report on the Pink Bollworm Committee.* (Allahabad, 1933. Abstr. from *Rev. App. Ent.*, Ser. A, **12**, 1933, p. 644.) In April, 1933, this Committee considered steps to be taken to give effect to a scheme for the control of *Platyedra gossypiella*, Saund., on cotton in the United Provinces by means of compulsory exposure of the seed at ginning factories to steam heat, and of that retained in villages to the sun. Financial and other aspects of the scheme are here discussed, and an outline of the suggested necessary legislation is given.

233. PINK BOLLWORM (*Pectinophora gossypiella*, SAUND.). By F. S. Li. (In Chinese with English summary.) (*Ent. and Phytopath.*, Nos. 11, 12, and 13, Hangchow, China, 1933. Abstr. from *Rev. App. Ent.*, xxi., Ser. A, **12**, 1933, p. 683.) *Platyedra* (*Pectinophora*) *gossypiella*, Saund., has two generations a year in Shanghai, and requires about forty-eight days to complete its life-cycle. The pupal period of the resting-cycle larvæ is much longer than that of the summer brood. It is the most destructive cotton pest in China, injuring the flower-buds, flowers, bolls and squares, and seriously affecting the strength, weight, and grade of the cotton fibre. In 1931 it was responsible for a loss of approximately £5,000,000, with an average of 24s. an acre. The usual methods of control are recommended, particularly those designed to destroy the resting-cycle larvæ.

234. LE TRAITEMENT DES GRAINES DE COTON ET DE BLÉ PAR LA CHLOROPICRINE. By C. R. Shabetai. (*Ann. Epiphyties*, xviii., **6**, 1933, Paris. Abstr. from *Rev. App. Ent.*, xxii., Ser. A, **1**, 1934, p. 6.) Since the treatment of cotton seed with hot air to kill larvæ of *Platyedra* (*Pectinophora*) *gossypiella*, Saund., is liable to destroy its germinating power if the temperature is high enough to ensure the death of all larvæ in large quantities of seed, studies on its treatment with chloropicrin were resumed. In infested seed suspended in a muslin bag inside a sealed flask, the larvæ were destroyed in 1, 24, and 72 hours respectively by chloropicrin at concentrations equivalent to 100, 8-10 and 5 oz. to 1,000 cubic feet. In tests, the technique of which is described in detail, to determine the effect of these (or sometimes higher) dosages on the germination of the seed, the maximum reduction was only 8·8 per cent. The development and yield of plants grown from the treated seed were normal.

235. PINK BOLLWORM: CONTROL BY CHLOROPICRIN. By — Bouvier and C. R. Shabetai. (*Compt. rend. Acad. Agr. France*, **19**, 1933, p. 76. Abstr. from *J. of Text. Inst.*, xxiv., **12**, 1933, A604.) Effective control of the insects is recorded, without loss of germinative power of the seed. The diastase activity of the seeds was not affected.

236. EGG-LAYING HABITS AND FATE OF EGGS OF THE CORN EARWORM MOTH (*Heliothis obsoleta*) AND FACTORS AFFECTING THEM. By W. J. Phillips and G. W. Barber. (*Virg. Sta. Tech. Bull.* 47, 1933. Abstr. from *Exp. Sta. Rec.*, 69, **6**, 1933, p. 829.) "The moths prefer the moist corn silks for oviposition, and these silks reach their greatest attractiveness on the third day after they are formed. Early in the season, before silks appear, eggs are deposited on all parts of the plants. . . . From a study extending over four years and involving 4,712 eggs in two localities, and on two varieties of corn, the following facts are evident. Only a small percentage of the eggs deposited on the plants hatch. *Triphleps insidiosus* destroys large numbers of eggs on silks, stalks, husks, and tassels, and relatively few on the leaves. *Trichogramma minutum* parasitizes more eggs on the upper surface

of the leaves than on any other part of the plant. . . . The importance of *Triphleps* increased as the season advanced. *Trichogramma* was most effective as a parasite of the eggs in mid-June, and was less important as a controlling agency later in the season."

237. CUTWORMS AS PESTS OF COTTON AND OTHER CROPS IN TRANSCAUCASIA. By V. N. Rekach. (In Russian, with summary in English.) (*Trans. Transcaucasia Cotton Sci. Res. Inst.*, No. 40, Tiflis, 1933. Abstr. from *Rev. App. Ent.*, xxi., Ser. A, **11**, 1933, p. 576.) Notes, partly based on the literature, are given on the bionomics of cutworms that cause considerable injury to cotton in Transcaucasia, the principal species recorded since 1927 being, in order of importance, *Euxoa segetum*, Schiff.; *E. temera*, Hb., f. *hübneri*, Bours.; *Agrotis* (*Rhyacia*) *ypsilon*, Hfn.; and *A.* (*R.*) *c-nigrum*, L. *Feltia exclamationis*, L., *E. conspicua*, Hb., and *A. flammatra*, Schiff., were also observed, but caused only slight damage.

238. THE BROWN CUTWORM AS A COTTON PEST. By T. H. Strong. (*Queens. Agr. Jour.*, xl., **5**, 1933, p. 396.) A description of the brown cutworm (*Euxoa radians* Guen.) and the injury caused to cotton plants. Control measures suggested are the elimination of weeds, and the use of poison-bran bait, the formula of which is as follows: 25 lb. brain, 1 lb. Paris green, 1 quart molasses dissolved in 2 quarts of water, and more water as required to make a crumbly, well-moistened bait. The bait must not be taken beyond the crumbly state, otherwise it will be difficult to scatter. For light broadcasting at least 50 lb. dry weight of bran per acre is required.

239. MEKRAN: POSSIBLY THE COUNTRY OF ORIGIN OF THE GREAT LOCUST INVASION OF SIND IN 1926. By Y. Ramchandra Rao. (*Ind. J. of Agr. Sci.*, iii., **5**, 1933, p. 833.)

240. THE LOCUST OUTBREAK IN AFRICA AND WESTERN ASIA IN 1932. By B. P. Uvarov. (*Econ. Adv. Coun. Comm. Locust Contr.*, 1933, price 3s. Abstr. from *Rev. App. Ent.*, xxii., Ser. A, **1**, 1934, p. 45.) In continuation of the survey for 1925-31 the breeding and migrations in 1932 of *Schistocerca gregaria*, Forsk., *Locusta migratoria migratoriodes*, R. and F., and *Nomadacris septemfasciata*, Serv., are discussed in detail and illustrated by a series of maps. Appendices contain a note on the occurrence of *Patanga succincta*, L. (Bombay locust), in the Unfederated Malay States, and a list of papers on the locust and grasshopper problem, supplementing that published with the previous survey.

[*Cf.* Abstr. **113**, Vol. XI. of this Review.]

241. KENYA COLONY. *Locust Campaign.* By D. L. Blunt. (*Rpt. Dpt. Agr. Kenya*, 1932.) The organization of the campaign and the methods of control employed are discussed. Baits were supplemented by power sprayers, which proved invaluable where the presence of water made their use practicable. In comparison with hand pumps, their high initial cost is saved in sodium arsenite alone within two months, and the area that can be treated within a given time is considerably greater than with any other apparatus.

242. SECONDO CONTRIBUTO ALLA BIBLIOGRAFIA DELLE CAVALLETTE. By G. Trinchieri. (*Rass. econ. Colon.*, xxi., Nos. 3-4, 5-6, Rome, Minis. Colon, 1933. Abstr. from *Rev. App. Ent.*, xxi., Ser. A, **12**, 1933, p. 643.) This bibliography of 1,211 references forms a supplement to those contained in the author's earlier work on locust control.

243. A THEORY OF MIGRATIONS OF THE MIGRATORY LOCUST. By L. Z. Zakharov. (In Russian.) (*Plant. Prot.*, **3**, 1932, p. 123. Leningrad, 1933. Abstr. from *Rev. App. Ent.*, Ser. A, xxi., **12**, 1933, p. 635.) The activity of *Locusta migratoria*, L., in the North Caucasus is discussed, and the hypothesis is advanced that any

movement of the locust indicates that it is not in an optimum condition and is trying to gain one. Hunger, deficiency or excess of heat or humidity and gregariousness all act as stimuli, producing an impulse to change the position of either the separate organs or the whole body. The optimum conditions are accompanied by the minimum amount of movement, and in the ideal state by its complete absence. This quiescent state should be distinguished from heat and cold stupors, during which the responsiveness of the organism to stimuli is lowered or completely lost, for during optimum conditions the insect remains capable of immediate reactions to any external stimulus. The seasonal behaviour of locusts is determined as much by the seasonal changes in weather as by the physiological changes within the organism, and there is no qualitative difference between the behaviour of hoppers and that of adults, which are directly comparable. The seasonal behaviour of *L. migratoria* in the North Caucasus is described, and it is suggested that the migrations of swarms from reed-beds into drier and warmer steppes where they breed is caused by excessive coolness and dampness prevailing in the former during the autumn.

244. CONTRIBUTION À L'ÉTUDE BIOLOGIQUE DU CRIQUET MIGRATEUR (*Locusta migratoria capito*, SAUSS.) DANS LES FOYERS PERMANENTS. By B. N. Zolotarevsky. (*Ann. Apiphyties*, xix., **1-2**, Paris, 1933. Abstr. from *Rev. App. Ent.*, xxii., Ser. A, **1**, 1934, p. 8.) A detailed account of the author's observations in different parts of the permanent breeding area in Madagascar in the course of several years and under different conditions.

245. THE PROBLEMS OF THE SPRING SURVEY OF THE INFESTED AREAS OF MIGRATORY LOCUST EGG-PODS. By L. Z. Zakharov. (*Plant Prot.*, No. 2, Leningrad, 1933. Abstr. in *Rev. App. Ent.*, xxi., Ser. A, **11**, 1933, p. 621.)

246. THE RED LOCUST. By W. V. Harris. (*Pamph. No.* 10, *Dpt. Agr. Tanganyika*, 1933. Abstr. from *Rev. App. Ent.*, xxi., Ser. A, **12**, 1933, p. 671.) Notes are given on records of the occurrence of *Nomadacris septemfasciata*, Serv., prior to 1929, with an account of the movements of swarms in Tanganyika Territory in 1930-32, during which breeding was confined to the Ufipa area. In 1933, breeding and migrations were more extensive, some swarms passing into Uganda and the Ruanda-Urundi Territory of the Belgian Congo. A description is given of hoppers and adults and illustrations of the phases, with some biometric measurements of the adults and particulars on the bionomics of this locust in Tanganyika. The hoppers feed mainly on grasses and cereals; the adults also attack ground-nuts, pigeon pea, beans, acacia and other trees, cruciferous vegetables, citrus, and banana.

247. FURTHER NOTES ON THE BIOLOGY OF THE RED LOCUST. By M. C. Mossop. (*Rhod. Agr. J.*, xxx., **12**, 1933, p. 1007.)
[*Cf.* Abstr. **114**, Vol. XI.]

248. DESCRIPTION OF HOPPER INSTARS OF THE RED LOCUST (*Nomadacris septemfasciata*, SERV., PHASE *gregaria*), AND SOME CHANGES IN ADULT COLOURATION. By M. C. Mossop. (*Proc. Rhod. Sci. Ass.*, xxxii., p. 113, Salisbury, 1933. Abstr. from *Rev. App. Ent.*, xxi., Ser. A, **12**, 1933, p. 643.) In the spring of 1933 *Nomadacris septemfasciata*, Serv., was observed to have six hopper instars in Southern Rhodesia; each of these is described. An account is given of the colour changes in adults. The hind wings assumed a purplish-pink colour by June-July, and by August the colours of the body darkened. Early in December, 1932, the general appearance of maturing adults was dark red, which turned to yellow by the middle of the month.

249. A Preliminary Note on the Breeding Grounds of the Desert Locust (*Schistocerca gregaria*) in Baluchistan. By K. R. Karandikar. (*Ind. J. Agr. Sci.*, iii., **5**, 1933, p. 847.)

250. Locust Birds. By A. M. Campbell. (*Farming in S. Afr.*, viii., **92**, 1933, p. 444.) The name " locust bird " is commonly applied to five different families in three different orders. One belongs to the starlings (*Passeres*), two to the plovers (*Limincolæ*), and two to the storks (*Herodiones*). The first is the wattled starling, which builds in the vicinity of locust hatcheries. The next two are known as the " little locust birds," and are *Pratincoles*. The two families differ slightly, one having brown wing coverts and the other black. The last two are storks, and are called the " great locust birds." One is white, while the other is black with white underparts. All these birds are of very great importance in agriculture, and do immense good by preying on the locust swarms, which are their main article of diet.

251. The Life-History, Bionomics, and Control of the White-Fly of Cotton (*Bemisia gossypiperda*, M. and L.). By M. A. Husain and K. N. Trehan. (*Ind. J. Agr. Sci.*, iii., **5**, 1933, p. 701). *Summary.* The life-history of *Bemisia gossypiperda* has been studied, and its various stages described. There may be twelve generations in a year, but the broods overlap. The eggs are laid singly on the underside of leaves; the maximum number of eggs laid by a female in 18 days was 119. The incubation period extends from 3 to 33 days. The duration of the nymphal stage varies from 9 to 81 days, the pupal period lasts from 2 to 8 days. The average duration of life-cycle from April to September is 17·5 days. The longest life-cycle extends to 107 days between November and February. The adults, as a rule, emerge during the daytime and are short-lived during summer. The progeny from parthenogenetic eggs consists of males only. Infestation, as a rule, is severest on cotton during July and August. The white-flies do not show any particular preference for different varieties of cotton. The incidence of attack on the early sown crop was comparatively higher up to September, after which it was practically uniform on all the sowings. There is not much difference between the cotton sown between May 1 and June 1, but the cotton sown later escapes the attack of the pest. The intensity of attack was higher on the manured plants, but plants treated with soda nitrate at 1 maund per acre showed comparatively less attack. The normal infestation of white-fly does not very much interfere with the vegetative growth, but the development of floral buds is hindered, and the shedding percentage increases. Shedding and bad opening of bolls are directly proportional to the intensity of attack. Parasitization in nature was observed to reach a maximum of 33 per cent. of the pupæ during September. Some predators have also been noticed. Over three dozen different plants, including weeds and cultivated crops, have so far been recorded as alternative host plants of the cotton white-fly. Cross inoculation gave successful results in case of a number of alternative food plants. Spraying of cotton fields with rosin compound once in August, or twice, once in July and again in August, has given encouraging results.

252. The Mass Rearing of *Microbracon brevicornis*, Wesm. By G. C. Ullyett. (Reprinted from *S. Afr. J. of Sci.*, xxx., 1933, p. 426.) The status of *Microbracon brevicornis*, Wesm., as a parasite of cotton pests is briefly reviewed. The choice of a laboratory host for the mass production of the parasite is discussed and the reasons given for the selection of *Plodia interpunctella*, Hb. The methods employed for the rearing of *Plodia* on a large scale are described, together with those used in collecting the larvæ. The technique of parasite rearing is outlined, and methods of cold storage, mailing, and liberation are described.

253. Recent Advances in the Study of Plant Viruses. By K. M. Smith. (J. and A. Churchill, London, 1933. From *Rev. App. Mycol.*, xii., **12**, 1933, p. 776.) The subject-matter dealt with in this attractively got-up and handy volume gives a survey of the present position of the knowledge of plant viruses, and is intended also to serve as a student's reference book until the progress and correlation of knowledge allows a more comprehensive treatise to be written. Within these limits the subject is exhaustively treated, each chapter being followed by a full bibliography of the relevant original work. Eleven chapters are given to a general account of symptoms, properties, transmission, physiology, etc., of virus diseases, their relation to insects being very fully discussed. A useful glossary of the technical terms used in virus investigations is appended. The illustrations are numerous, and the letterpress clear. The book should be of interest and value to all plant pathologists.

254. Investigations of the Mechanism of the Transmission of Plant Viruses by Insect Vectors—I. By H. H. Storey. (Amani Memoirs. Reprinted from the *Proc. of Roy. Soc.*, B, Vol. 113, 1933.) *Summary*. This paper deals primarily with experiments in the mechanical inoculation of insects with plant viruses. The method employed was the introduction of the virus into a puncture of the abdomen or leg made with a finely pointed needle or glass micro-pipette. A large proportion of the insects survived this treatment. The inoculation of active races of *Cicadulina mbila*, the vector of streak disease of maize, was successful, when the inoculum introduced was the juice of diseased maize seedlings, fresh or kept for four but less than eight days, undiluted or diluted with distilled water by 10^{-2} (rarely, by 10^{-3}). Inoculation by causing the virus fluid to be drawn up into the rectum per anum failed. By the inoculation of the appropriate fluids, it was shown that the virus was present in infective active *C. mbila*, (*a*) in the contents of the rectum, if the insect has recently fed on a diseased plant, but not otherwise; (*b*) in the general contents of thorax or abdomen; and (*c*) in the blood, whether the insect had fed recently upon diseased or healthy plants. The virus was not found in the naturally voided fæces. The appearance of the virus in the blood preceded in time the development of the power to cause infections. Inactive races of *C. mbila*—normally unable to transmit the virus—were made infective by needle inoculation with the streak virus. The proportion of successes was, however, significantly less than with active races. After a feed on a diseased plant, the inactive insect was found to have the virus in its rectum, but never in its blood. A simple puncture of the abdomen with a sterile needle, either following or followed by a feed on a diseased plant, sometimes caused inactive *C. mbila* to become infective. By comparison of the efficacy of different positions for the puncture, it was concluded that the treatment was successful only if the needle had penetrated some part of the intestine. Inactive races of *C. zeæ* proved to be susceptible to inoculation with the streak virus by the methods successful with *C. mbila*. *C. mbila* was not successfully inoculated with the viruses of maize stripe and mosaic diseases; nor *Peregrinus maidis* and *Aphis maidis* with the virus of streak. It is concluded from these observations that in active *C. mbila* the streak virus, entering the intestine by mouth, passes through the intestinal wall into the blood; and that, in the inactive insect, the cells of the intestinal wall resist the passage of the virus. It is recognized that there may be some secondary mechanism of resistance; nevertheless, in many inactive individuals, once the barrier of the intestinal wall has been passed, the virus behaves as in an active insect.

255. Cotton Diseases (trans. title). By A. A. Iachevskii. (*Trudy Prikl. Bot. Genet. and Plant Breeding*, 24, **5**, 1930. Abstr. from *Exp. Sta. Rec.*, 69, **3**, 1933, p. 374.) In this extensive monograph cotton diseases are dealt with under the

chapter headings of historical data (pp. 3-30), and diseases of cotton in various regions (pp. 31-266). Data are presented on such topics as the physiology of the causative organisms, descriptions of varieties, and disease control. References given include about 198 from foreign literature and 20 from the Russian.

256. THE INFLUENCE OF ENVIRONMENTAL CONDITIONS ON THE DEVELOPMENT OF THE ANGULAR LEAF-SPOT DISEASE OF COTTON. V. THE INFLUENCE OF ALTERNATING AND VARYING CONDITIONS ON INFECTION. By R. H. Stoughton. (Reprint from *Ann. App. Biol.*, xx., **4**, 1933, p. 590.) Experiments on the influence of variations in the environmental conditions on the bacterial disease of cotton plants caused by *Bacterium malvacearum* are described. A regular diurnal variation in soil temperature is shown to have the same effect on primary infection of seedlings as a constant temperature near the mean of the fluctuations. The mean soil temperature at the time of sowing, and for the first few days of germination, is the chief controlling factor in primary infection, other factors being equal. Subsequent variations in the soil temperature have little effect on the incidence of the disease. The amount of disease resulting from infection of the seed—*i.e.*, primary infection—is higher at soil moisture contents approaching saturation than at normal moisture contents in a given type of soil. The amount of primary infection at a given soil temperature and moisture content varies with the type of soil. A regular diurnal variation of air temperature has the same effect on secondary infection resulting from spray-inoculation of young plants as a constant temperature near to, or slightly above, the mean of the variations. Other things being equal, the amount of infection resulting from spray-inoculation depends upon the mean temperature prevailing during the incubation period of the disease, the actual temperature at the time of inoculation being unimportant. Atmospheric humidity is a conditioning factor in secondary infection only during a short period (less than forty-eight hours) following inoculation. Its importance lies in its control of the time during which the infection droplets persist. Once penetration of the tissues has been effected variations in the external humidity have little direct effect. Plants kept in total darkness are relatively resistant to infection. Plants grown in continuous light are no more susceptible than those grown under a daily period of seventeen hours' illumination of approximately 1,200 foot-candles. The time of inoculation in relation to the period of illumination does not appear to have any marked effect on the amount of infection. The relations of the whole series of experiments on the influence of environmental conditions are discussed.

[*Cf.* Abstr. **89**, Vol. VI.; **103**, Vol. VIII.; **202**, Vol. IX.; **279**, Vol. X. of this Review.]

257. GROWTH RELATIONS IN CULTURE OF THE COTTON ROOT-ROT ORGANISM (*Phymatotrichum omnivorum*). By E. J. Moore. (*Phytopath.*, xxiii., **6**, 1933, p. 525. Abstr. from *Rev. App. Mycol.*, xii., **11**, 1933, p. 691.) The writer's laboratory experiments at Texas University showed that a given culture of the cotton root-rot organism (*Phymatotrichum omnivorum*) grows at a fairly constant rate on potato-dextrose agar, but that different isolations varied considerably, one recently isolated, for instance, averaging nearly three times the rate maintained by two others that had been kept for long periods on artificial media. On addition to potato-dextrose agar cotton-root extracts greatly accelerated the rate of elongation of the hyphæ. On the other hand, freshly prepared maize root extracts, either alone or combined with potato-dextrose agar, proved strongly toxic to all the strains of *P. omnivorum* tested. Such water-soluble substances present in maize roots are labile, but show a diminished toxicity on ageing. Small doses of the toxin appear to stimulate the growth of the fungus. A similar toxic effect was exerted in varying degrees by extracts from the roots of *Malvaviscus*

conzattii (the only species of Malvaceæ known to be highly resistant to *P. omnivorum*), wheat, and barley. It is considered, therefore, that the water-soluble, labile substances present in the roots of plants immune from infection by *P. omnivorum* play a part in the establishment of this condition.

258. Further Notes on the Nematodes Associated with the Soreshin of Cotton. By J. R. Christie and C. H. Arndt. (*U.S. Dpt. Agr., Bur. Plant Indus., Plant Dis. Rpt.*, 17, **1**, 1933. Abstr. from *Exp. Sta. Rec.*, 69, **5**, 1933, p. 670.) Numerous cotton seedlings were studied directly as collected from several fields in South Carolina in the spring of 1932 to obtain further information on the prevalence of various species of nemas in diseased seedlings. The preliminary results obtained indicated that various species of nematodes may cause the original injury through which fungi and bacteria invade the cortex, or if the nematodes do not initiate the lesions, they apparently are important agents in their enlargement.

259. Cotton Worm Fungus: Occurrence in Egypt. By R. M. Nattrass. (*Min. Agr. Egypt. Tech. Sci. Serv. Bull. No.* 120, 1933. Abstr. from *Summ. of Curr. Lit.*, xiii., **23**, 1933, p. 611.) Notes on the entomogenous fungi of Egypt include an account of a species of *Empusa* parasitizing the cotton worm when kept in captivity. No worms have yet been found attacked in their natural state.

GENERAL BOTANY, BREEDING, ETC.

260. Development of the Female Gametophyte and Embryo in Cotton. By U. R. Gore. (*Amer. J. Bot.*, 19, **10**, 1932, p. 795. Abstr. from *Exp. Sta. Rec.*, 69, **3**, 1933, p. 357.) The development of the female gametophyte and early stages of embryo development were studied in Sea Island, Pima Egyptian, and Upland cottons of the Delfos 6102 and Mebane varieties at the Texas A. and M. College. The embryo sac was observed to develop from the chalazal megaspore of the tetrad, the complete structure being very long and embedded in many layers of nucellus. The antipodals degenerate early, and the polars begin fusing before entrance of the male gametes to form a polar fusion nucleus. The pollen tube enters the ovule fifteen to twenty hours after pollination, and by digesting its way through the nucellus reaches the embryo sac. Slight branching of the tube in the region of the integuments was noted. Fertilization is completed from twenty-four to thirty hours after opening of the flower. The endosperm in cotton usually results from the fusion of the second male gamete with the polar fusion nucleus. Various methods of triple fusion are reported. A massive endosperm is developed only to be resorbed by the growing embryo. The embryo develops a short suspensor.

261. A Note on a Growth Abnormality of Punjab-American Cottons. By M. Afzal. (*Ind. J. Agr. Sci.*, iii., **5**, 1933, p. 933.) During certain years American cotton grown in the Canal Colonies of the Punjab is affected by a peculiar growth abnormality which appears to be of the nature of a virus disease. The attacked plants show very characteristic symptoms. The internodes, petioles, and leaves are extremely reduced in size. The leaves are crinkled, deformed, and discoloured, and yellowish patches give them a characteristic mosaic appearance. The reduction in the size of leaves is also accompanied by a reduction in the number of lobes. The stipules are usually of the normal size, but are very light in colour. The floral organs are very much reduced in size. The epicalyx is discoloured, but not deformed. The shedding of buds and bolls is very high, leading to a high degree of sterility of the plant, and the few bolls which are formed are very small in size and give but few viable seeds. The attack may

either be confined to a few limbs, or the entire plant may be affected. The degree of severity of attack on the shoot is marked by a fairly proportionate reduction in the size of the root system. It has been ascertained that the disease is similar to "stenosis" or "smalling," described by Cook in America. The attack is confined to American varieties, while the indigenous cottons seem entirely immune. The attack was first noticed during 1930, but it practically disappeared during 1931, and appeared again with startling severity during 1932. The extent of damage done can be judged from the fact that in several fields at Lyallpur, in which counts of the abnormal plants were made, nearly 50 per cent. of the plants were affected. The attack commences when the plants are six weeks old, and the disease is very virulent during August.

262. A Note on the Occurrence of Small Outgrowths on the Calyx Ring of the Cotton Flower. By C. Jaganatha Rao. (*Madras Agr. J.*, **21**, 1933, p. 394. From *Plant Breeding Abstracts*, iv., **2**, 1934, p. 115.) A description of an anomaly occurring in a pure line of cotton, No. 54, a "Northerns" selection (*Gossypium indicum*), grown at the Research Station, Nandyal. In F_1 hybrids the character has proved partially dominant.

263. The Relation of Size and Shape of Plant to the Yield of Cotton. By S. N. Venkataraman and C. J. Rao. (*Madras Agr. J.*, 21, **2**, 1933, p. 51. Abstr. from *Exp. Sta. Rec.*, 69, **3**, 1933, p. 358.) The relation of height, nodes, and number of monopodia to the yield of cotton was studied in 6,000 plants, the progeny of forty-six selections of Northerns cotton (*Gossypium indicum*).

In plants of the same strain, number of monopodia and plant height were correlated markedly with yield, whereas the genetic relation from strain to strain was different. While taller types were not necessarily good yielders, strains with more monopodia were more productive. The number of nodes was not of much significance towards yield, either within or between strains. The correlation of yield to other characters was significantly greater in normal plants than in those attacked by the shoot borer (*Earias* sp.). Study of the regression of plant yield on these characters showed that the relation of monopodia and, to a large extent, of height was rectilinear, indicating a proportionate increase of yield with increase in these characters. Examination of yield from plants in all strains showed attacked plants to give a significantly higher yield, this increase being associated with an increase in number of monopodia per plant and in an increased rate of productivity per monopodium. A comparison of other strains, as Cambodia and particularly Uppam (*G. herbaceum*), where the effect of the borer was the reverse, showed the difference in behaviour could be attributed to the more monopodial habit of this type. The relation of yield to monopodia was much higher in this cotton than in more sympodial types.

264. Lint Colour in Asiatic Cottons. By V. R. Ayyar and R. B. Iyer. (*Current Sci.*, 2, p. 128. Mysore, 1933. From *Plant Breeding Abstracts*, iv. **2**, 1934, p. 114.) From ratios obtained in F_2 and F_3 progenies of inter-specific crosses of *Gossypium obtusifolium*, *G. indicum*, and *G. herbaceum*, a 3-factor basis for lint colour in these cottons is postulated. A basic gene X, essential for colour but producing pigmentation only in the presence of either K_1 or K_2 or both, is regarded as the probable factor relationship. The factor X with either K_1 or K_2 gives cream; X with K_1 and K_2 gives brown. Further work is in progress.

265. Genetic Relations of Red Plant Colour, Leaf Shape, and Fibre Colours in Upland Cotton. By J. O. Ware. (*Bull. No.* 294, Univ. of Arkansas Agr. Exp. Sta., 1933.) Plants having green plant colour, normal shape leaves, and green lint colour were crossed with plants having red plant colour, okra-shape leaves, and white lint. The former plants were used as the female parents.

Thirteen crosses were kept separate and propagated as families. Several other crosses were massed and carried as a miscellaneous group. The thirteen families and the miscellaneous group were all grown in the F_2, but for the back crosses, the F_3 and F_4, not all families were included. However, sufficient populations were studied in these later generations to provide ample material for the solution of the problem.

In the F_1 generation the plants were all intermediate in a rather uniform degree for each of the three characters. Because of the intermediate condition of the three characters, the F_2 segregated into twenty-seven classes, thus exhibiting all the genotypes.

The goodness of fit test, made by the X^2 method, indicated that the observed numbers in seven of the thirteen families and in the miscellaneous group deviated from the calculated numbers to a significant degree, while it showed that the fluctuations in the other six families were attributable to chance only. The dispersion noted in certain of these families doubtless was caused by inability accurately to sort some of the classes. However, when the F_2 material was regrouped according to the phenotypic classes, the X^2 values showed that all groups except family 12 and the miscellaneous were well within the range of probability which indicates insignificant departure. With the two groups in which poor agreement between the observed and expected numbers existed, adjustments made by recomputing the calculated numbers, according to a differential classification of one of the monohybrid relationships in each case, caused the X^2 value to be lowered to a point where significant departure did not obtain.

In the back-cross studies, it was necessary to use the genotypic classification, and, since this was done, more error of classification appeared than would have been the case with a phenotypic classification. However, in practically every case where such errors did occur they were smoothed by recomputation of the expected classes according to a differential classification that appeared in one of the character pairs. The F_3 and F_4 data were classified according to genotype, but were given a phenotypic grouping in this study. In a few cases poor agreement occurred in some of the families in the F_3 and F_4, but these were of small consequence after adjustments for faulty classification were made.

The F_3 and F_4 generations were grown, respectively, on the basis of F_2 and F_3 genotypes. Ample numbers of the twenty-seven F_2 genotypes were propagated for the F_3, and these same kinds of genotypes that appeared in the F_3 were again grown for the F_4. These genotypes in both generations, whether heterozygous for three, two, or one pair of factors, segregated according to expectation, the expected phenotypic ratio for three pairs being 27: 9: 9: 3: 9: 3: 3: 1, for two pairs 9: 3: 3: 1, and for one pair 3: 1. The genotypes that were homozygous for one, two, or three pairs of characters bred true for all cases where homozygosity prevailed.

The F_2 data, where the three-character pairs for plant colour, leaf-shape, and lint colour were studied as trihybrid, or when any two of the three characters were studied as dihybrids, showed that there is independent assortment among these characters.

In the back-cross work the three possible two-character combinations of the three indicated independent inheritance for the characters concerned. The F_2 and F_3 genotypes, whether they were those that segregated for three- or two-character pairs in the following generation, further confirmed the F_2 and back-cross evidence that red plant colour, okra-shape leaf, and green lint colour are independently inherited characters.

266. The Inheritance of Virescent Yellow and Red Plant Colours in Cotton. By D. T. Killough and W. R. Horlacher. (*Genetics*, 18, 4, 1933, p. 329.

Abstr. from *Exp. Sta. Rec.*, 69, 5, 1933, p. 639.) Virescent-yellow cotton, a new type studied at the Texas Experiment Station, is greenish-yellow when young, but the chlorophyll gradually increases in amount so that the mature plants are not readily distinguishable from normal green plants. Virescent yellow (v) is a simple recessive to green (V). Red leaf (R), produced by the distribution of anthocyanin pigment throughout the plant, appeared to be a simple dominant to green leaf (r), confirming results of others. R and V are inherited independently. R in combination with v resulted in a new type termed bronze.

267. Effects of Plant Spacing and Irrigation on Number of Locks in Cotton Bolls. By A. R. Leding and L. R. Lytton. (*J. Agr. Res.*, xlvii., 1, 1933, p. 33.) Practically all the bolls produced by American Upland varieties of cotton have either 4 or 5 locks or carpels. The number of locks, although regarded as a heritable character, is affected by cultural conditions. Several investigators have noted the effects of changed or unfavourable conditions of growth upon various characters of the cotton plant. Among the effects observed was reduction in the number of locks per boll. An example of the effect of close spacing or crowding of cotton plants upon the number of locks was observed by the writers in 1926, in experiments at the United States Acclimatization Field Station at State College, New Mexico. In two of these experiments it was found that the closer spacings consistently produced higher proportions of 4-lock bolls, and these relations were studied more intensively in the following year. Comparisons of lock numbers were made in four spacings: Single plants, 12 inches apart in the row; two plants to 12 inches; plants left in groups, or " blocked-out "; and plants left without thinning. No difference was shown between one and two plants at 12 inches, but the experiment with blocked-out plants showed 10 per cent. more 4-lock bolls than the 12-inch spacing, while the plants that were not thinned showed nearly 17 per cent. more 4-lock bolls. Numerous blocks were compared, and as a general rule the percentage of 4-lock bolls was higher or lower as the number of plants per foot in the rows increased or diminished. Further data along the same lines were obtained in 1928.

In addition to observations in the regular spacing tests in 1928, another experiment was conducted for studying the combined effects of different irrigation and spacing treatments in relation to the production of 4-lock bolls. Two widely different spacings of the plants and two methods of irrigation were employed in this experiment, the spacings being: (1) one plant to 18 inches, and (2) unthinned plants; and the irrigation methods being (1) normal, and (2) " light." In the light irrigation method the moisture supplied to the plants was less than is normally required. It was again found that the closer-spaced plants had produced considerably higher percentages of 4-lock bolls, but it was also evident that the irrigation practice had had an effect, the light-irrigated plants producing more 4-lock bolls than those which received a normal amount of water. The effect of spacing, however, was evidently greater than that of irrigation.

In 1929 the effect of spacing in the regular tests was again studied, and similar data were obtained as in the two preceding years. In addition, the combined spacing and irrigation experiment was repeated, and the difference in irrigation treatments was intensified by applying still less water to some of the plants. Since it is possible that on account of differential shedding of 4-lock and 5-lock bolls the effects of cultural conditions may be shown more definitely in the flowers than in the bolls, and in order to obtain a larger array of data, a different procedure was followed. Instead of waiting until the end of the season a daily examination was made of the flowers as they bloomed, the number of carpels being determined by the stigma lobes. On the basis of daily flower counts a large number of comparisons between spacing treatments were made, and in much the greater number

of cases the close-spaced plants produced more flowers with 4 carpels. Similar daily comparisons of the effects of irrigation treatment showed higher percentages of 4-carpel flowers among the plants under restricted moisture conditions, although in not so many instances as under the different spacing. Average percentages of flowers with 4 carpels covering the entire season as affected by spacing showed differences of nearly 25 per cent. in the stressed sections, and a little more than 30 per cent. in the normally irrigated sections, while under the different irrigation treatments the differences were about 3½ per cent. in the unthinned plants, and a little over 9 per cent. in the 18-inch spaced plants.

The data, on the whole, indicate that the amount of space available for the development of the plants has a material influence upon the proportion of 4-lock bolls produced; crowding the plants in the rows reduces the percentage of 5-lock bolls. The amount of moisture in the soil is also a determining factor, although apparently it is of less importance than the spacing of the plants.

268. PROGRESSIVE MUTATIONS INDUCED IN *Gossypium hirsutum* BY RADIATIONS. By W. R. Horlacher and D. T. Killough. (*Amer. Nat.*, 67, 1933, p. 532. From *Plant Breeding Abstracts*, iv., 2, 1934, p. 148.) The progressive mutations from forked leaf shape to normal produced in cotton, *Gossypium hirsutum*, by X-ray treatment of the dry seeds, and from virescent yellow leaf and plant colour to normal green leaf and plant colour, have been described. Genetic evidence is here presented to show that these two mutations have been transmitted to succeeding generations. The colour mutation is regarded as particularly interesting, since it represented the reversal under X-rays of a mutation that had previously occurred in nature—*i.e.*, from green to virescent yellow and back again to green.

[*Cf.* Abstr. **150**, Vol. IX.; **628**, **629**, Vol. X., of this Review.]

269. PLANT BREEDING IN THE SOVIET UNION. (Pubd. by Imp. Bur. of Plant Genetics, Cambs. and Aberystwyth, November, 1933. Price 3s. 6d.) An account of the achievements, organization, and future programme of work of the Institute of Plant Industry, Leningrad. The Institute, under the direction of Professor N. I. Vavilov, has in the past fifteen years organized the greatest experiment in plant breeding yet witnessed. A systematic study has been made of the economic plants of the whole world with the object of making a collection as complete as possible on which to base the breeding work of the future. These studies have led to the discovery of the centres of origin of the main cultivated plants, and to the further discovery that these centres are at the same time the points at which the greatest number of forms and characters of the plants concerned are concentrated, and so represent the source of the most valuable initial material for plant breeding. This material has been assembled in the Soviet Union, and subjected to systematic study, on the basis of which monographs on the systematics of the primary crop plants have been compiled or are in course of preparation.

In view of these new opportunities the breeding work of the Soviet Union has been entirely revised. A Conference on the Planning of Breeding and Genetic Investigations was held in Leningrad in June, 1932, at which Professor Vavilov outlined the programme of research in general and specific crop genetics which will be put into operation during the second Five-Year Plan. In his address Professor Vavilov discussed the general principles of genetic investigation in a way which is applicable not only to Soviet breeders, but to breeders and geneticists in the whole world. The address is published *in extenso* in the congress report, and is followed by the detailed programme for work on the individual plants and problems. These two contributions are of such value to any breeder about to prepare or revise his breeding programme that the Imperial Bureau of Plant

Genetics have had them translated into English, and in an almost unabridged form they constitute the nucleus of the present publication.

The genetic work in cotton growing which is in progress, or to be commenced, is concerned with the following:

(1) Immunity: resistance to wilt in order to improve and increase the yield of Upland and Egyptian species and Americo-Egyptian hybrids: (*a*) acquired immunity; (*b*) immunity as influenced by vernalization and time of sowing.

(2) Vegetative period with reference to improving yield and extending the crop into new regions: (*a*) early ripening (in relation to the height of formation of first sympodium): Upland, Egyptian; (*b*) vernalization: Upland, Egyptian.

(3) Technological characters: (*a*) the length of fibre with reference to improving and increasing yield: Upland, Egyptian, local cottons; (*b*) fibre yield with reference to improving yield: Upland, Egyptian, and Americo-Egyptian hybrids.

(4) Characters connected with mechanization: (*a*) shape of bush (extreme types of branching): Upland, Americo-Egyptian hybrids; (*b*) degree of dehiscence of pods: Upland, Egyptian; (*c*) naked seed for mechanization of sowing: Upland.

(5) Specific characters: (*a*) percentage of ovaries shed with reference to increasing yield: Upland, Egyptian, and local cottons; (*b*) the size and shape of pod and number of faces as factors of yield; (*c*) resistance to stormy weather.

In addition the following general problems are under investigation:

(1) Interspecific hybridization: (*a*) Upland × Egyptian, in order to combine high yield and high quality of fibre; (*b*) Upland × local cottons, in order to combine earliness, resistance to storms, and yield; (*c*) South-American perennial cotton × Egyptian cotton, in order to obtain large-sized bolls in Egyptian.

(2) Crossing of geographical races of cotton, in order to obtain the highest possible diversity of valuable combinations of agricultural characters: Egyptian, Upland, local cottons.

(3) Heterosis of Americo-Egyptian hybrids, and an attempt to fix it in order to obtain high yield and high quality plants.

(4) Artificially induced mutations, in order to obtain early, cold resistant, and other valuable forms; also to obtain polyploid and polysomic forms.

(5) Biology of flowering in relation to problem of genetico-breeding work.

(6) Morpho-genetic analysis of agricultural characters from the point of view of the origin of forms.

(7) Non-heritable variations and permanent modifications.

270. VERNALIZATION: A NEW METHOD OF SHORTENING THE VEGETATIVE PERIOD OF PLANTS. By N. von Gescher. (*Int. Rev. Agr.*, xxiv., **10**, Rome, 1933, p. T410.) In the last fifteen years the great importance of the periodicity of the light falling upon a plant has come to be fully recognized, and Lyssenko has shown that what applies to light applies to other factors influencing the rhythm of plant development. If it were possible to influence artificially the external factors—that is to say, the sum total of the factors determining the development of a given plant, and more particularly its transition from the vegetative to the reproductive stage—it would be possible to cultivate this plant in regions entirely different from those which are natural to it. This is one of the objects of Lyssenko's work.

It is particularly with regard to the nature of the influence of light that the researches of Lyssenko and his co-workers have introduced new knowledge, which, if it is confirmed, will change the conception of photoperiodism of the numerous workers, American and Russian in particular, who are concerned with this phenomenon.

271. FOR HIGH YIELD AND QUALITY OF EGYPTIAN COTTON. By A. I. Avtonomov, (*Sredaznihi, Moscow and Tashkent*, 1933. From *Plant Breeding Abstracts*, iv., 1, 1933, p. 64.) A general description of Sea Island cotton and its various forms

is given, the annual *Gossypium barbadense* being of most interest for the Soviet Union, and different varieties, of the Ashmouni and Pima type, being compared with the typical Uplands. The various attempts to improve the native Central Asiatic cottons by introduction and selection are outlined, including the selection by Navrotskii of the different varieties of this name, and the final successful introduction of Sea Island cottons.

The several factors which result in variation and deterioration are discussed, and a brief outline is given of the principles of inheritance, pure line selection, and cross-breeding.

In breeding Egyptian cottons the main problems are to increase the earliness, so as to enhance the yield in southern districts, and extend the cultivation northward; to reduce boll shedding; to improve the lint quality of the highest yielding and earliest varieties, which are all deficient in this respect; to increase also the lint yield in those varieties with the best quality and most uniform lint; to increase the size of boll; to reduce the rather high demands of the best varieties in respect of cultural conditions; to produce types resistant to gummosis, to frost and cold, and suitable for mechanical cultivation in and between the rows, and for mechanical harvesting. The ultimate desire is to combine all the qualities in one variety. The methods of achieving these various aims by breeding are briefly outlined. Promising results have been obtained by crossing the Egyptian cottons with the large-bolled perennial Peruvian cottons, with the aid of a reduction of the length of day to nine hours for the Peruvians and hybrids. The perennial cottons introduce large size of bolls, abundant fruit bearing, length of lint, frost resistance; their deficiency in earliness and ginning percentage is made up for by the annual Egyptian forms with which they are crossed, these being also characterized by high quality of lint. Amongst the varieties already produced are a Pima four to seven days earlier than the normal type, and with ginning percentage 3 to 4 per cent. higher; one with equally good lint and a yield 30 to 50 per cent. higher; and line 4066 from Ashmouni with lint length equal to Maarad (48 mm.), yielding 20 to 30 per cent. more than Ashmouni, which it equals in earliness.

272. THE GENERAL NATURE OF THE GENE CONCEPT. By R. R. Gates. (*Nature*, **132**, 1933, p. 768. From *Plant Breeding Abstracts*, iv., **2**, 1934, p. 105.) The implications arising out of the phenomena of stability and inherited change exhibited by the gene plasm have formed the basis of the gene concept. With advancing knowledge the former morphological outlook has been rejected in favour of an essentially physiological viewpoint according to which the gene, as a living unit, is regarded as an organized system, thus partaking of the nature of all organic units. The nature of this organization leading to the conception of the gene is discussed from the point of view of the visible differences arising from initial germinal differences, and of the theories of chromosome structure and evolution.

273. THE CYTOLOGICAL METHOD IN PLANT BREEDING. By G. A. Levitsky. (*Bull. App. Bot.*, Leningrad, 1933, Ser A., 5-6. From *Plant Breeding Abstracts*, iv., **1**, 1933, p. 27.) After a brief discussion on the nature of the cell constituents the author refers to the decisive rôle played by karyology in the systematics of the wheat species, and the occurrence of parallel polyploid series also in a number of other genera; it is pointed out, however, that differences in chromosome number are frequently found in quite small systematic units, and by no means correspond to specific differences. Thus it is of great importance to choose races with appropriate chromosome numbers before making a cross.

274. CYTOLOGICAL STUDIES IN THE *Malvaceæ* AND CERTAIN RELATED FAMILIES. By J. H. Davie. (*J. Genet.*, **28**, 1933, p. 33. From *Plant Breeding Abstracts*, iv., **2**, 1934, p. 114.) For different species of ten Malvaceous genera, seventeen

new chromosome numbers are recorded; and species of *Hibiscus, Gossypium, Thespesia, Cienfugosia*, and *Theobroma* were included in the main study. In general there was considerable uniformity in the size and shape of the chromosomes. The tendency to group association of chromosomes at metaphase is regarded as an indication of the polyploid nature of most of the genera examined, which are presumably derived from an ancestral type with the basic number 7.

The polyploidy on a basis of 7 attributed to *Gossypium* and other genera is reconciled with the diploid numbers recorded by postulating fusion of two pairs of chromosomes into one long pair; and the possible course of events in the evolution of the various types of *Gossypium* from the ancestral type is outlined.

Observations of mitosis and meiosis confirmed and extended the theory of secondary association of chromosomes in polyploids, and in *Thespesia* and *Gossypium* in particular. In contrast to Darlington's findings definite evidence of secondary pairing in somatic tissue was observed.

The extent of the agreement between the taxonomy and the cytology of the *Malvaceæ* is examined from the phylogenetic standpoint, and four cytologically independent types of evolutionary change are recognized in the *Malvaceæ* so far examined—viz., polyploidy, tetraploidy, on a basis of 7, hexaploidy and octoploidy through the tetraploid form from the ancestral diploid as in *Hibiscus africanus majus*.

The origin of the genus *Gossypium* appears to have involved tetraploidy on a basis of 7, followed by fusion of two pairs of chromosomes into one pair, thus giving $n=13$ as the fundamental number for the genus. From the so-called diploid Asiatic cottons, which are really modified tetraploids, have arisen the so-called tetraploid American cottons, which are phylogenetically modified octoploids. The "tetraploid" American cottons have not necessarily a common ancestor. Amphidiploidy has probably occurred in the different hybrids which resulted from crosses between various related ancestral diploid species. In this way the American cottons, with $2n=52$, may have arisen from separate ancestors.

A bibliography of fifty references is included.

275. THE CYTOLOGICAL MECHANISM FOR CROSSING OVER. By K. Sax. (*Proc. 6th Int. Cong. Genet.*, **1**, 1932, p. 256. From *Plant Breeding Abstracts*, iv., **1**, 1933, p. 24.) The various genetic phenomena of crossing-over which any cytological theory is expected to explain are enumerated, together with the postulates of Belling and Darlington's theories of meiosis. Various objections to these are put forward, amongst which are the facts that haploid *Zea* chromosomes are split at early leptotene, and that little or no sister strand crossing-over, twisted strands, or asymmetrical chiasmata have been observed.

According to the author's theory crossing-over occurs only when the chromatids break at a chiasma, chiasmata being caused by alternate opening out of sister and non-sister chromatids; breakage only occurs when asymmetrical chiasmata are formed. The proportion of these is very small, except in certain organisms characterized by extreme frequency of crossing-over, a fact which is regarded as supporting McClung's rather than Janssens' theory of chiasmata. In support of his theory the author refers to the reduction in chiasma frequency, even in the *Zea*-teosinte chromosomes where no terminalization is possible, and where the number is halved, not entirely cancelled; the behaviour of unequal homologues, where the chromatids of equal length pair; the greater frequency of proximal interlocking than of distal; the occurrence of cross-overs in non-disjunction lines of Drosophila; the pairing observed in chromosomes where no crossing-over takes place; the frequency of chiasmata in *Vicia Faba* in comparison with the degree of crossing-over.

The author considers that chiasmata in the Drosophila male terminalize without breaking, possibly owing to the duration of meiosis, which is different in male and female.

276. NEUERE ERGEBNISSE ÜBER DIE GENETIK UND ZYTOLOGIE DES CROSSING-OVER (RECENT RESULTS IN THE GENETICS AND CYTOLOGY OF CROSSING OVER). By C. Stern. (*Proc. 6th Int. Cong. Genet.*, **1**, 1932, p. 295. From *Plant Breeding Abstracts*, iv, **1**, 1933, p. 23.) In spite of the controversy which still rages as to the manner of crossing-over, investigators are agreed that the chromosomes regularly interchange portions during the reduction division, that this presupposes a pairing of homologous chromosomes, that the chiasmata play an important rôle in the interchange, and that the chromosomes are at the time of interchange already divided into two chromatids.

The series of experiments which led to the detection of the precise time at which crossing-over occurs is reviewed briefly, and it is shown how both the genetic and cytological evidence indicate that crossing-over takes place at gametogenesis, between two chromatids, and that it is dependent upon chromosome pairing, and that the extent of crossing-over roughly corresponds to the number of chiasmata. Crossing-over has now been cytologically demonstrated, on chromosomes both ends of which are morphologically recognizable, and in all cases observed there has been exact correspondence between the genetic crossing-over and the cytological crossing-over.

277. RELATION OF CHROMATID CROSSING-OVER TO THE UPPER LIMIT OF RECOMBINATION PERCENTAGES. By R. A. Emerson and M. M. Rhoades. (*Amer. Nat.*, **67**, 1933, p. 374. From *Plant Breeding Abstracts*, iv., **1**, 1933, p. 23.) The reason for the limit of recombination percentage lying at 50 is thought to be in the random crossing-over of the chromatids, since each point of cross-over produces two cross-over and two non-cross-over strands. A table is given showing that the percentage of parental combination to recombination strands is 1:1, regardless of the relative frequency of single, double, and other multiple cross-overs—*i.e.*, independently of interference.

278. THE CONJUGATION OF THE CHROMOSOMES. By H. Federley. (*Proc. 6th Int. Cong. Genet.*, **1**, 1932, p. 153. From *Plant Breeding Abstracts*, iv., **1**, 1933, p. 28.) Chromosome pairing, whatever may be its ultimate cause, is known to be influenced by the structure of the chromosomes, the genotype of the individual, and the environmental conditions of the cell and the individual. One essential for conjugation is homology of the chromomeres along the length of the chromosome, and where translocations have occurred chiasmata fail to be formed. That homology is not the only factor is illustrated amongst other things by the irregular conjugation in many amphidiploids, and that a polyploid species sometimes gives autosyndesis when crossed with one species, and complete absence of it when crossed with another. The danger of drawing taxonomic deductions from chromosome pairing is evident from such results. Meiosis may be quite different in the pollen and embryo sac mother cells. With regard to the external influences, conjugation seems to be particularly susceptible to the influence of temperature. Finally, various cases of definite genes influencing conjugation are quoted.

279. CHROMOSOME STUDY AND THE GENETIC ANALYSIS OF SPECIES. By C. D. Darlington. (*Ann. Bot.*, **47**, 1933, p. 811. From *Plant Breeding Abstracts*, iv., **2**, 1934, p. 106.) Since the study of the chromosomes of related species at mitosis has demonstrated that the main divisions of the taxonomist are sustained by the cytologist, the systematist can therefore apply cytological discoveries to the elucidation of species problems that have defied analysis on taxonomic lines.

Further and still more conclusive evidence in species problems can also be derived from the observations of meiosis in hybrids between related forms, for, from the chromosome associations occurring at metaphase, diverse changes in genetic structure can be inferred. From such behaviour of hybrids it has been possible to conclude that most related species differ in chromosome structure.

Differences exist between the connotations of the term hybrid as defined by the cytologist and geneticist, on the one hand, and the taxonomist on the other, and many taxonomic species are recognized by the cytologist as hybrids.

The development of new forms is favoured not only by geographical, but also by genetic isolation due to structural and numerical changes in the chromosomes. These latter changes, though they do not as a rule establish those morphological differences which are the essential criteria of species, are nevertheless an important factor in permitting the development of such differences (by gene mutation) in the strains they isolate.

It is clear that cytological and complementary genetical work can advance the study of species chiefly by the analysis of their internal constitution.

280. A CONTRIBUTION TO THE THEORY OF QUANTITATIVE CHARACTER INHERITANCE. By J. Rasmusson. (*Hereditas*, **18**, 1933, p. 245. Abstr. from *Plant Breeding Abstracts*, iv., **1**, 1933, p. 22.) As a result of long experience in applied genetics the Swedish geneticists have come to the conclusion that 100 to 200 genes are concerned in the inheritance of most quantitative characters. In opposition to the assumption that the factors act additively and independently, the author quotes the failure to obtain homozygous types superior to the parents from crosses between highly improved parents, and the frequent delay in the fall in yield to the second and later generations on inbreeding.

A new theory of quantitative factor inheritance is presented, where it is assumed that " the effect of each factor on the genotype is dependent upon all the other factors present, the visible effect of a certain factor being smaller, the greater the number of factors acting in the same direction." The theory is referred to as the interaction theory.

281. TO DETERMINE GENETICAL RATIOS WHEN SELFING ORGANISMS HETEROZYGOUS FOR TWO OR MORE FACTORS. By M. C. Ferguson. (*Amer. Nat.*, **66**, 1932, p. 91. From *Plant Breeding Abstracts*, iv, **1**, 1933, p. 23.) A method of application of the expanded binomial for the calculation of the number and constitution of genotypes and phenotypes is described, whereby the process of calculation is facilitated.

282. HYBRID INCOMPATIBILITY AND THE ORIGIN OF POLYPLOIDY. By A. Muntzing. (*Hereditas*, **18**, 1933, p. 33. From *Plant Breeding Abstracts*, iv., **1**, 1933, p. 28.) A discussion of various views on the nature of the incompatibility which almost invariably exists between forms differing in chromosome number, whether spontaneous or artificially produced, is presented, in which emphasis is laid on the identical behaviour of auto- and allo-polyploids.

283. LA MITOSE SOMATIQUE DU COTONNIER (THE SOMATIC MITOSIS OF COTTON). By A. Eichhorn. (*C. R. Seanc. Soc. Biol.*, **112**, Paris, 1933, p. 260. From *Plant Breeding Abstracts*, iv., **2**, 1934, p. 148.) The appearance of the nucleus before mitosis in cotton is described as being intermediate between the type with " chromocentres," and that with " prochromosomes " already distinguished by the author. In the resting nucleus there is to be found the large nucleolus to which is attached a small granule of chromatin and a large number of granulations more or less grouped together in twos and threes. When mitosis commences the granulations unite to form the small and regular chromosomes, and mitosis proceeds in a normal way.

284. Das "Leica"-Kleinbildverfahren im Dienste des Züchters. By F. Christiansen-Weniger. (*Züchter*, **5**, 1933, p. 213. From *Plant Breeding Abstracts*, iv., **2**, 1934, p. 121.) The advantages of the "Leica" miniature photographic process as an aid in plant-breeding work are described in detail. *Inter alia* it is claimed that enlargements from small photographs taken by this process are sharp and clear in detail. Pictures can be taken by artificial light, while, by means of a special attachment, stereoscopic photographs can be obtained.

285. Die Züchtung der Baumwolle. Eine Bibliographische Monographie. By E. Taschdjian. (*Z. Züchtung*, A, **18**, 1933, p. 627. From *Plant Breeding Abstracts*, iv., **2**, 1934, p. 147.) This monograph embodies the author's notes on the literature of cotton breeding during three years spent in theoretical and practical research on that subject.

286. État Actuel et Premiers Résultats des Travaux d'Amélioration Exécutés en Égypte sur le Coton et le Blé par le Dr. B. Kajanus. By A. Siedemann. (*Bull. Un. Agric. Égypte*, **30**, 1932, p. 65. From *Plant Breeding Abstracts*, iv., **2**, 1934, p. 113.) A description of the work of the late Dr. Kajanus on selection and hybridization of cotton, wheat, and oats. Two types of cotton, Maarad and Zagora, after selection for five generations, have shown a definite improvement in yield and quality. The length of fibre in millimetres was 42·2 for Maarad and 31·0 for Zagora.

287. Gossypol: Properties. By H. D. Royce and F. A. Lindsey. (*Ind. Eng. Chem.*, **25**, 1933, p. 1047. Abstr. from *J. of Text. Inst.*, xxiv., **12**, 1933, A661.) Gossypol is the chief natural anti-oxidant in cotton seed. The stabilizing effect of pure crystalline gossypol added to refined cotton-seed oil has been measured by means of Methylene Blue fading time, and peroxide-accelerated oxidation curves. Gossypol inhibits the saponification of cotton-seed oil by "Kontakt" catalyst. It also plays an important rôle in the alkali refining of crude, hot-pressed cotton-seed oil. The presence of gossypol in most hot-pressed oils can be shown by using the aniline-pyridine precipitation method; and, by moderate heating of oils to which pure gossypol has been added, it is shown that a crude oil may contain up to 0·2 per cent. heat-modified gossypol which cannot be precipitated by any known method. Refining losses on certain oils have been lowered 1 to 3 per cent. by the addition of fractional percentages of pure gossypol. A refining theory for hydraulic-pressed cotton-seed oils which show abnormal losses is outlined.

288. Hydrogen Ion Concentration and its Practical Application. By F. L. LaMotte *et al.* (Baillière, Tindall and Cox, London, 1932. Price 20s. Abstr. from *Bull. of Imp. Inst.*, xxxi., **3**, 1933, p. 460.) Of the two general types of methods for determining pH values—*i.e.*, potentiometric and colorimetric—the latter only is described as it is the one more usually employed, but the discussion also includes reference to instances where colorimetric measurements do not agree with the electrometric values. The greater part of the book is devoted to the practical application of hydrogen-ion determinations in industry and science, and in this connection a large number of different industries are dealt with. In these fourteen chapters, the authors have condensed into workable schedules a vast amount of data derived from practical experience. The methods outlined are simple and effective, and, together with the data presented, form a useful guide for routine and research work. A useful feature of the book is the lists of selected references to literature dealing with the various subjects discussed.

FIBRE, YARN, SPINNING, WEAVING, ETC.

289. British Cotton Industry Research Association. (*Rpt. of* 14*th Ann. Gen. Mtg.*, 1933.) In his speech the Vice-Chairman, Mr. H. S. Butterworth, stated that there had been two notable extensions to the Institute during the year: the provision of a large shed to carry out experiments on new blow-room machinery, and the provision of a fading station. One of the objects of this new station was to enable the dyer to determine quickly what the probable behaviour of fabrics would be on exposure to sunlight for some time.

Dr. R. H. Pickard, the Director of Research, in his remarks, dealt with the attitude of the trade to the Research Association. He stated that the contact of the staff with the trade had been largely increased, and that the work of the Shirley Institute tended to weld together, on the technical side, the different sections of the industry.

290. Possibilities of Chemical Research in the Cotton Industry. By C. E. Mullin. (*Text. Rec.*, li., **609**, 1933, p. 47.) A brief discussion of a few of the major chemical problems concerning the manufacture, bleaching, dyeing, and finishing of cotton goods.

291. Cotton: Specific Heat. By W. C. Marley. (*Proc. Phys. Soc.*, **45**, 1933, p. 591. Abstr. from *J. of Text. Inst.*, xxiv., **12**, 1933, A603.) A brief review of existing methods of determining specific heats is given with reference to their suitability for poor conductors. The method of cooling is developed to afford an accurate and ready method. The specimen is contained in a vacuum flask, 30 cm. deep and 5 cm. in internal diameter, which fits tightly into a metal cylinder immersed in a bath maintained at constant temperature by melting ice. The annular space between the flask and cylinder is filled with water to ensure good thermal contact, and the specimen occupies the flask to a definite level. A thermometer in the specimen shows the rate of cooling. The rate of heat transfer is less than 0·003 calorie per second for a 1° C. temperature difference between inside and outside. A value of $0{\cdot}30_4$ at 18° C. is found for cotton-wool of 3·3 per cent. moisture content, and is compared with results from three other observers.

292. Fibre Abnormalities and Pressure Variations within the Boll in Gossypium. By W. K. Farr. (*Amer. J. Bot.*, 19, **10**, 1932, p. 839. Abstr. from *Exp. Sta. Rec.*, 69, **3**, 1933, p. 357.) Pima Egyptian and Super Seven and Acala Upland cottons showed increasing numbers of fibre abnormalities in the order named, and in the ratios of 15: 90: 170. Very few abnormalities occurred before the twentieth day from fertilization in any one of the cottons. Measurements during the entire period of development indicated that pressure within the boll is relatively small in Pima, moderate in Super Seven, and large in Acala, and that it increases from the twentieth day until near dehiscence. The possibility was suggested that pressure may be an important factor in the formation of fibre abnormalities.

293. Fundamentals of Fibre Structure. By W. R. Astbury. (Oxford Univ. Press, 1933. Abstr. from *J. of Text. Inst.*, xxiv., **11**, 1933, P286.) In this review it is stated that the author has compiled the book from a series of his lectures, and has written in a manner which makes it remarkably easy to read and understand. The reader is led by stages from an excellent short description of the fundamental nature of matter and radiation to a good mental picture of the internal structure of textile fibres. The author explains the practical connection between the in-

tricate structural systems of the fibres and technically important phenomena, such as moisture regain, swelling, and tension effects. By this means a clearer understanding is obtained of the many textile problems which are difficult to explain without reference to the results of X-ray experiments. Many excellent diagrams and photographs are included in the book.

294. Hair Hygrometer Moisture Content Determination Apparatus. By A. Pfeiffer. (*Chem. Fabr.*, **6**, 1933, p. 406. Abstr. from *J. of Text. Inst.*, **xxiv.**, **12**, 1933, A643.) A simple and rapid method for determining the moisture content of hygroscopic material consists in putting it into a small box of known volume, the lid of which has a hair hygrometer on the inside and a scale on the outside. The reading of the hygrometer after equilibrium has been established inside the box is a measure of the moisture content of the substance tested. The vapour pressure is determined relative to that over pure water, so that the results are really independent of temperature.

295. Cotton Hair: Spiral Structure. By W. Seifriz. (*Sci.*, **77** and **78**, 1933. Abstr. from *Summ. of Curr. Lit.*, xiii., **23**, 1933, p. 630.) The author discusses instances of spiral growth and structure in the animal and vegetable kingdoms, and on a large and small scale, from trees to cotton fibres. He concludes that it is a fundamental heritable protoplasmic quality, and not caused by external mechanical forces.

296. The Study of Cotton and Yarns. (*Text. Weekly*, xii., Nos. 296, 298, 302, and 308, 1933.) Part I. deals with Scientific Characters to help practical men; II. The Value of Staple Length Diagrams; III. Predicting Yarn Properties from Fibre Characters; IV. Prediction of the Spinning Value of a Cotton.

297. Planimeter: Application in the Textile Industry. By J. Walther. (*Leipz. Monats. Text. Ind.*, **48**, 1933. Abstr. from *Summ. of Curr. Lit.*, xiii., **23**, 1933, p. 630.) Various methods of measuring surfaces are outlined, and the advantages of the planimeter method are pointed out. Examples illustrating the use of the planimeter for the determination of the area of cross-sections of fibres, and in the evaluation of staple diagrams and the records obtained on yarn-testing devices are given.

298. The Truth about Sisal as a Bale Covering for Cotton. (Pubd. by American Manufg. Co., Brooklyn, New York, U.S.A.)

299. The Cleaning of Cotton. By J. H. Harrison. (*Text. Weekly*, xii., **293** and **294**, 1933.) A brief explanation of the cleaning action that takes place at each machine as the cotton passes from the state of a bale to that of a comber sliver.

300. Cotton Opening and Cleaning Plant: Function of Air Currents in. By R. Setzer. (*Text. Lloyd*, vii., 1933, Nos. 11, 16, 18. Abstr. from *J. of Text. Inst.*, xxiv., **12**, 1933, A615.) It is pointed out that cotton opening and cleaning plant should provide for satisfactory opening and loosening of the cotton, and the removal of foreign substances and fibres of low value. The degree to which these requirements are fulfilled by the type of plant at present in use is discussed. Low-value fibres are defined, and the danger of losing good cotton with the low-value cotton and impurities is pointed out. The need for good mixing and for control of moisture content is emphasized. The advantages of pneumatic mixing are outlined; two forms of apparatus are described, and the conditions for satisfactory operation are briefly discussed.

301. Waste Losses in Cotton Opening and Cleaning Machines. (*Text. Weekly*, xii., **307**, 1934, p. 555.) Describes a method for obtaining accurate results.

302. COTTON: OILING AND MOISTENING. By G. Hill. (Wellford, S. Carolina, E.P. 400,308 of 7/5/32. Abstr. from *Summ. of Curr. Lit.*, xiii., **23**, 1933, p. 615.) A method of oiling or moistening cotton and other fibrous materials during scutching or opening comprises separating the fibres, and applying liquid thereto substantially at the point of separation. By the point of separation is meant the point closely adjacent to the feed rollers where the cotton, retained by these rollers, becomes subject to the opening action of the beater arms. A machine for this purpose comprises a beater for separating the fibres, and one or more nozzles for supplying liquid to the separated fibres substantially at the point of separation.

303. A THEORETICAL AND PRACTICAL INVESTIGATION OF THE OPERATION OF THE LOOM. By Dr. I. E. Honegger. (*J. of Text. Inst.*, xxiv., **12**, 1933, T421.) Deals with the subject under the following heads: (1) Calculation and Measurement of the Power Consumption of the Various Parts of a Loom; (2) Comprehensive Measurements taken on the Loom when Driven by Various Types of Motors.

304. THE BEHAVIOUR OF COTTONS OF VARIOUS ORIGINS UNDER DEFINITE SWELLING PROCESSES. By K. Küsebauch. (*Int. Cott. Bull.*, xi., **44**, 1933, p. 703.)

305. RECENT IMPROVEMENTS IN TEXTILE MACHINERY. By F. Nasmith and W. English. (*Int. Cott. Bull.*, xi., **44**, 1933, p. 719.) In this useful paper the authors state that the greatest activity has been expressed in the blowing room, and practically every textile machinist in Great Britain has been responsible for one or more improved machines or systems. The general adoption of the single process system in this connection is most marked. In the spinning section various attempts have been made in the improvement of the ring frame, the development of large package spinning, and the introduction of new methods and machinery in relation to doubling. In the doubling section cone supplies have been advocated, and methods of magazining such supplies, providing thereby a practically inexhaustible supply of material, secure an economic production of high value. A new type of twisting frame for tyre yarns has proved a definitely practical proposition resulting in considerably reduced costs for the finished cord yarn. A new winding machine void of all reciprocating parts has been introduced to secure the higher speeds demanded today, and in the warping section by the employment of cone supplies the same object—namely, high speed and high production—is achieved. Comparatively little development is recorded in the weaving section—shuttleless looms, and a new loom the shuttle of which carries a very considerable amount of weft, being the most important. A let-off motion evolved by the Shirley Institute and mechanically perfected by a firm of loom makers is worthy of notice.

306. SPINNING TESTS ON SELECTED BALES OF SEA ISLAND, AMERICAN-EGYPTIAN, AND EGYPTIAN-SAKELLARIDIS COTTON. By M. E. Campbell. (*U.S. Dpt. Agr., Bur. Agr. Econ. and Bur. Plant Indus.*, 1933, p. 17. Abstr. from *Exp. Sta. Rec.*, 69, **6**, 1933, p. 906.) Parallel spinning tests were made on two bales of selected South Carolina Sea Island cotton—one each of the 1929 and 1930 crops—developed by the U.S. Dept. of Agriculture, and selected commercial bales each of Florida Sea Island, American-Egyptian (Pima), and Egyptian-Sakellaridis cotton. The Sea Island lots were found considerably superior in strength, the Sakel slightly superior, and the Pima about average, when compared with results of earlier tests of cotton of corresponding varieties. According to the strength data for yarns and to the observations made during manufacture, the Sea Island cottons studied meet well the specifications of yarns for fabrics intended for mechanical purposes, demonstrating and substantiating the fact that the present Sea Island stock compares favourably in spinning quality with the Sea Island cotton of earlier years.

307. Cotton Yarn: Costing. By W. H. Slater. (*Text. Weekly*, **12**, 1933. Abstr. from *Summ. of Curr. Lit.*, xiii., **22**, 1933, p. 610.) (1) An example is given in tabular form of the correct method of calculating the cost of cleaning cotton per pound of conditioned yarn. This involves the use of the author's table of Cotton Constants, and enables the comparative costs of cleaning for yarns spun from cotton of different waste losses or regains to be determined, and also the variations in cost which would arise from spinning a yarn from the same stapled cotton from a range of cottons that would produce different waste losses. The importance is stressed of costing on conditioned, not dry yarn. (2) The author shows in a table that mills costing on the dry weight of cotton as spun at the spindle point, instead of on conditioned yarn weights as sold, will show considerably less than the actual loss for cleaning, so that a heavy unconscious loss will result.

TRADE, CO-OPERATION, ETC.

308. The World Economic Crisis. By Dr. A. Niemeyer. (*Text. Rec.*, li., **609**, 1933, p. 23.) Discusses the depreciation of values in the German textile industry.

309. The Causes of the Depression in the World's Cotton Industry, and Means to Overcome Them. By O. Bankwitz. (*Int. Cott. Bull.*, xi., **44**, 1933, p. 524.) An exhaustive study of the question. In the author's view the depression is caused by undue increase in the total number of spindles, lack of world co-operation, and over-production and price-cutting caused by working double shifts of twelve and eleven hours in Japan and China. He stresses the need for European combination and standardization of working hours, the universal adoption of a forty-hour week, and abolition of the double shift.

310. Progress in the Lancashire Cotton Industry. (*Text. Rec.*, li., **610**, 1934, p. 19.) Discusses price agreements and international trade bargaining as a means of combating depression.

311. Lancashire Cotton Corporation. (*Text. Weekly*, xii., **305**, 1934, p. 496.) Conspicuous recovery has taken place in the affairs of the Corporation since the appointment of the present directorate and the complete reorganization of trading methods.

312. The Reorganization of Canada's Cotton Industry. By M. Meek. (*Text. Rec.*, li., 609, 1933, p. 27.) A brief history of the Canadian cotton manufacturing industry, established in 1844. During the past five years a complete internal reorganization of the industry has taken place. Nearly all mule spindles have been scrapped, and ring-spinning frames substituted, automatic looms have replaced non-automatic looms, the installation of high-speed warping and winding equipment has effected desirable economies, and card-room processes have been entirely reorganized. In addition, dyeing and finishing equipment has been improved, and adapted to handle cloth production in accordance with modern requirements. The main object underlying the work of reorganization is bulk production of finished cotton goods with the utmost operating efficiency.

313. Textiles in China. (*Text. Rec.*, li., **610**, 1934, p. 66.) Deals with the many changes that have recently affected the economic life of China, the present policy of the Government, and the extent to which this policy, if successful, will affect the market for foreign goods, including those of British manufacture.

314. Textiles in South Africa. (*Text. Rec.*, li., **610**, 1934, p. 66.) "It is to be noted with some satisfaction that there is now an increased tendency towards

luxury buying in South Africa. It is also noticed that cheap textiles are not being bought so extensively as was the practice a year ago. There is more employment. Wage and salary cuts have in most cases been restored. The public is realizing that the cheaper types of textiles cannot be compared with the more expensive products of British manufacture. Quality is now an important consideration, and British textiles are again featured in South African stores."

315. Cotton Rubber-Lined Fire Hose. By H. R. Mauersberger. (*Melliand Text. Monthly*, **5**, 1933. Abstr. from *Summ. of Curr. Lit.*, xiii., **23**, 1933, p. 634.) The manufacture of cotton rubber-lined fire hose consists of the following steps: (*a*) spinning the yarn; (*b*) weaving the jacket; (*c*) mending, mildew proofing, and inspection of the hose; (*d*) making the rubber lining; (*e*) the insertion of the lining into the jacket; (*f*) curing the lining in the jacket; (*g*) attaching the coupling to the hose. Each step is briefly described, and the tests and specifications set up by the National Board of Fire Underwriters are given together with suggestions for the care of fire hose.

316. Cotton: Conversion into Petroleum Products. By E. Kerl, and (1) H. Biebesheimer, (2) W. Dienst. (*Liebig's Ann. Chem.*, **504**, 1933. Abstr. from *Summ. of Curr. Lit.*, xiii., **23**, 1933, p. 639.) The authors discuss the possibility that vegetable matter is the precursor of petroleum, and may be converted into this by the chemical and physical action of mineral deposits. By heating cotton with *N*-caustic soda (or chalk or dolomite) at 310-330° under 180-200 atm. pressure, they have obtained a " proto-product " which becomes like asphalt on exposure to the air, and yields petroleum-like oils on hydrogenation or cracking.

MISCELLANEOUS.

317. Reports on the Work of Agricultural Research Institutes and on Certain Other Agricultural Investigations in the United Kingdom, 1931-32. (Min. of Agr. and Fisheries, London, 1933.) This volume outlines the progress of agricultural research carried out with the aid of State funds during the academic year 1931-32 at Research Institutes and other centres in the United Kingdom. A numbered list of the papers published during the year by each Institute or research centre is appended to each report, and references to the numbers of these papers are included in the text. A list of the names and addresses of Directors of Research Institutes and persons in charge of investigations at other centres is given in the Appendix. An index is also included in the volume.

318. The Imperial College of Science and Technology. In the 26th Ann. Rpt. of the Governing Body for the year ending July 31, 1933, it is stated that the year was marked by steady development on established lines of the educational work of the College, rather than by any notable change. The total number of students registered was 1,157, or 45 in excess of the number in 1932. Many important matters were considered during the year, including: The conditions governing the conduct of work for outside bodies; the extension of Entrance Scholarships beyond the normal period; the suitability to present-day requirements of the existing system of Entrance Scholarships; changes in the Mining and Mining Geology Courses. The research work of the College continued to expand. The volume of the general research is evidenced by the number of Higher Degrees awarded to members during the year, including 7 Doctors of Science, 52 Doctors of Philosophy, and 26 Masters of Science—a total of 85. The Imperial College Hostel continued to fulfil an important rôle in the life of the College, the accommodation for 100 residents being fully utilized throughout

the year. The new sick-room was found a valuable addition to the Hostel facilities, and the insurance scheme, arranged with the co-operation of the Medical Officer, proved its usefulness.

ADDENDA.

319. The Marketing of Cotton: From the Grower to the Spinner. By J. A. Todd. (Sir Isaac Pitman and Sons, Ltd., 1934. Price 10s. 6d. net.) With his facile pen, Mr. Todd has brought together into a very readable volume a vast mass of information. The book is intended primarily for members of the cotton trade in Liverpool, but it is equally useful to those in other sections of the Lancashire cotton industry who desire to have full knowledge of the working of the Liverpool market and other organized markets of the raw cotton trade throughout the world. Students of economics will also find the book of much interest.

After a consideration of supply, demand, and consumption, the author deals (Chap. III.) with the primary markets, in which the cotton is sold by the actual growers. An interesting description is given of the buying in a local American market, where prices tend to be against the seller, while the whole transaction is handicapped, as elsewhere, by the fact that neither buyer nor seller has an accurate idea of the value of the cotton for spinning purposes. This is followed by a lucid account of the principles of valuation by the double standards of grade and staple, and it is pointed out that reform is needed to enable the grower of a longer-staple cotton to get a better price, though for the present conditions the existing system, in which it is the buyers who take the risks, is reasonably good. The progress of the co-operative system is then described, and also the unsatisfactory method of baling. The primary markets in other countries are considered; and the Egyptian system is commended. The difficulties caused in India by illiteracy and by mixing are pointed out, and the systems in various parts of British Africa are discussed.

The next two chapters deal with the Liverpool market, and with the two divisions of the Spot and Futures markets. The understanding of this subject, which often presents such difficulties to an outsider, is made much more simple by tracing the evolution of the Liverpool market from the early days when a few auctioneers disposed of a few thousand bales, the then total import. The introduction of futures trading after the American Civil War, mainly by John Rew, is described, and the real meaning of trading in futures—to afford a hedge for contracts—is explained.

In Chapter VI. a very clear account is given of the complicated business of financing the cotton through its various stages on the way to the mills.

In Chapter VII. the way in which crop forecasts and other statistics, which are so valuable in their market influences, are prepared and disseminated is considered. A very useful detailed account is given of the methods of forecasting in use in America, and this is followed by descriptions of forecasting methods in India and Egypt.

Finally, in Chapter VIII., the subject of Government intervention—in connection with acreage restriction, regulation of markets, and actual purchase of excess supplies—comes up for consideration, and the results of the great interventions in the markets in America and in Egypt are discussed.

320. Memoirs of the Cotton Research Station, Trinidad. (Pubd. by the Empire Cotton Growing Corporation. Price 2s. 6d. post free.) The fifth number of Series B Physiology has recently been issued, and contains the following papers reprinted from the *Annals of Botany*:

Further Studies on Transport in the Cotton Plant. Part II. Preliminary Observations on the Transport of Phosphorus, Potassium, and

CALCIUM. By T. G. Mason and E. J. Maskell. 1. When a ring of bark is removed from the main axis of cotton between the foliage region and the roots, phosphorus, potassium, and possibly some other ash constituents, as well as carbohydrates and nitrogen, accumulate in the stem tissues above the ring and diminish below. There is also a significant accumulation of total ash, as well as of nitrogen and carbohydrates in the leaves above the ring.

2. The results obtained indicate that nitrogen, phosphorus, potassium, and other ash constituents ascend the stem mainly via the wood, are re-exported from the foliage, and move downwards towards the roots via the phloem. Calcium also ascends via the wood, but there is no evidence that it is re-exported from the leaf to move downwards via the phloem.

3. This downward movement of phosphorus and of ash may, like the parallel movement of nitrogen and of carbohydrates, be reversed by reversing the relative positions of leafy and leafless regions of stem. Data were not obtained for potassium.

4. The ratios of nitrogen, phosphorus, and potassium in downward movement to the carbohydrate in downward movement appear to be in excess of the ratios required for growth of the lower part of the plant. It is suggested that the excess may be liberated into the tracheal sap, and so again ascend the plant. This suggestion is supported by the composition of the tracheal sap, notably its low content of sugars as compared with mineral materials, and also the fact that as much as one-third of the nitrogen in the tracheal sap may be organic. It is pointed out that this return towards the roots of many of the mineral nutrients that have moved upward with the transpiration current must influence uptake by the roots from the external solution, and may in part explain why the effect of increasing transpiration rate on rate of salt uptake is so comparatively small.

5. The relative concentrations, in wood, bark, and leaf tissues of calcium, phosphorus, and potassium are in harmony with the view that phosphorus and potassium may be readily re-exported from the tissues they reach via the transpiration current, while calcium is re-exported much more slowly, if at all.

6. Removal of the growing bolls is followed by a marked increase in the concentrations of phosphorus and total ash as well as of nitrogen and carbohydrates in the leaves and stem tissues of the plant. Calcium also increases, but to a smaller extent.

7. Fertilization markedly increases the rate of uptake of phosphorus and total ash, as well as of carbohydrates and nitrogen, by the ovule, but has a smaller effect on the uptake of calcium. There is a similar effect in the carpels, but the divergence between the effect on calcium uptake and that on the uptake of total ash, phosphorus, and potassium is even greater than in the ovule. The results are in harmony with the view that phosphorus, potassium, and some other ash constituents travel to the boll along gradients in the phloem, while calcium moves mainly in the xylem.

8. Assuming that the rate at which water enters the young ovule, which is growing rapidly and is largely protected from transpiration, is of the same order as the rate of net gain in water, then the ratio of the increment of any material to the net increment of water should be an estimate of the order of concentration required in the incoming tracheal sap, if import were entirely via the xylem. For calcium the concentration so calculated is roughly of the order observed in the tracheal sap of the stem; for nitrogen, carbohydrates, total ash, and phosphorus, the concentrations indicated are vastly in excess of those found in the tracheal sap.

PART II. AN ONTOGENETIC STUDY OF CONCENTRATIONS AND VERTICAL GRADIENTS. By T. G. Mason and E. J. Maskell. 1. The changes, during development, in the amounts of different materials present in successive zones of the main axis of cotton are recorded by observations at monthly intervals.

2. Using three reference lines—namely, (i.) fresh weight, (ii.) water content, (iii.) total carbohydrate material—the following conclusions as to storage of different materials during development are reached: (*a*) Polysaccharides accumulate steadily, especially in the bark; (*b*) total N accumulates in the bark even more markedly than polysaccharides, but shows little, if any, accumulation in the wood; (*c*) phosphorus accumulates rapidly in the bark and also in the wood. It shows depletion from the lower zones during the final period; (*d*) calcium increases in the bark steadily up to the last collection, but only at about the same rate as fresh weight. It shows some accumulation in the wood; (*e*) potassium shows no sign of accumulation.

3. Where there is evidence of storage of material in the bark, the vertical concentration gradients (per 100 grm. water) are negative. Potassium, which in this experiment shows no sign of storage, has a consistent positive gradient. The results support the view that the observed negative gradients are due to a negative storage component masking a dynamic component of freely mobile material.

4. Storage of nitrogen in the bark takes place very largely as asparagine N, and this fraction is responsible for the observed negative gradient of crystalloid N. Residual N, on the other hand, maintains a consistent positive gradient, and may represent the mobile component.

5. The vertical gradients of sugar concentration and of total osmotic pressure in the bark are steep in the early stages when growth is more rapid, but flatten out as development proceeds. Electrolytes may contribute to the total positive osmotic pressure gradient.

321. Indian Central Cotton Committee. (*Ann. Rpt. to August* 31, 1933.) Another year of steady progress is recorded. The Cotton Transport Act and the Cotton Ginning and Pressing Factories Act worked smoothly. Further progress was made in the establishment of regulated cotton markets, and the arrangements made for the publication of forecast figures of the cotton crop proved satisfactory. The fumigation of American cotton to prevent the introduction of boll weevil into India was continued, 65,446 bales being fumigated, compared with 244,695 in the previous year.

In connection with research, eight new schemes, costing approximately Rs. 2,85,496, were sanctioned by the Committee; in all, funds were provided for thirty-two research and other schemes. The work of the Technological Laboratory maintained its high standard; 461 samples were spun as against 323 in the previous year, an increase of 43 per cent. The Institute of Plant Industry, Indore, successfully continued its work as the centre of cotton research for the black cotton soil tract of Central India.

PERSONAL NOTES

We much regret to announce the death of Mr. R. P. Scott, which occurred on November 29 last. Mr. Scott represented the Bombay Chamber of Commerce on the Administrative Council of the Corporation.

We offer our congratulations to the Rt. Hon. Lord Stanley on his appointment as a member of His Majesty's Privy Council. Lord Stanley is a member of the Administrative Council of the Corporation. Our congratulations are also extended to Sir Harry Lindsay on the honour of K.C.I.E. conferred on him. Sir Harry Lindsay represents the Government of India on the Administrative Council and Executive Committee of the Corporation.

We also tender our congratulations to Sir Geoffrey Evans on the honour of K.B.E. conferred on him. Sir Geoffrey Evans is Principal of the Imperial College of Tropical Agriculture, Trinidad, and Controller of the Corporation's Cotton Research Station in that island.

OFFICERS ON LEAVE.

When an officer of a colonial Department of Agriculture (or of the allied departments of Irrigation, Transport, etc.) comes " home " on leave, he usually brings with him much information that may be of considerable value to similar officers in other colonies, or to the officers of the Empire Cotton Growing Corporation, who have to collect, collate, and use all possible information relating to cotton. The Corporation would consequently much appreciate the courtesy if Directors of Agriculture and others would be so kind as to inform them, in advance if possible, of the names, probable addresses, and approximate dates of arrival in England of officers coming on leave. This would give the Corporation the opportunity of getting into touch with these officers themselves, and of giving the latter the opportunity of meeting with one another. A further courtesy would be conferred if the officers themselves, upon arrival, would call at, or inform, the offices of the Empire Cotton Growing Corporation, which are at the corner of Millbank and Wood Street (entrance by the first door in Wood Street), immediately opposite the offices of the Crown Agents for the Colonies.

At the date of writing, the following officers are on leave or will shortly be arriving in England, from cotton-growing countries:

Kenya Colony	Mr. M. H. Grieve.
,, ,, ...	Mr. J. McDonald.
,, ,, ...	Mr. F. B. Notley.
,, ,, ...	Mr. G. W. G. Briggs.
,, ,, ...	Mr. F. C. Buckley.
Nigeria	Mr. K. Hartley.
,, ...	Mr. H. G. Poynter.
,, ...	Mr. A. S. Swainson.
Sierra Leone	Mr. J. W. D. Fisher.
,, ,, ...	Mr. E. J. Nisbett.
Tanganyika Territory	Mr. W. C. Clarke.
,, ,, ...	Mr. R. M. Davies.
,, ,, ...	Mr. H. M. Lloyd.
,, ,, ...	Mr. G. W. Lock.
,, ,, ...	Mr. C. J. McGregor.
,, ,, ...	Mr. D. Thornton.
,, ,, ...	Mr. A. J. Wakefield.
Uganda	Mr. C. Hazel.
,, ...	Mr. W. T. O. Maidment.
,, ...	Mr. R. T. Wickham.

The following officers of the Corporation's staff abroad are on leave or will shortly be arriving in England:

South Africa	Mr. F. R. Parnell.
,, ,, ...	Mr. F. S. Parsons.
,, ,, ...	Mr. M. F. Rose.
Southern Rhodesia	Mr. G. S. Cameron.
Trinidad	Mr. S. H. Evelyn.
,, ...	Dr. A. Skovsted.

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THE EMPIRE COTTON GROWING REVIEW

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COTTON GROWING IN UGANDA

BY

G. F. CLAY

Assistant Director of Agriculture, Uganda

IN an article which appeared in the Journal of October, 1931, a short account was given of the history and development of cotton in Uganda up to the end of 1930. It is proposed to bring that account up to date, and also to give the reader a rather fuller idea of the economics of the Uganda cotton industry, and to outline the field-work of the Agricultural Department rather than the breeding work.

THE CROP.—The 1930-31 crop immediately succeeded the crop which is referred to in Uganda as the "Blackarm year," when with an acreage not much less than that of 1928-29 there was a fall in the crop from 204,000 to 129,000 bales, this fall, although due in part to unfavourable climatic conditions, being greatly accentuated by an epidemic occurrence of blackarm in the more northerly parts of the Eastern Province. On account of the decreased viability of the seed in the blackarm areas, and also with a view to the encouragement of the growers, Government distributed in the affected areas 1,730 tons of seed from South Busoga at a cost of £8,000. The crop exported in 1931 totalled 191,300 bales of 400 lbs. net.

In the 1931-32 season the acreage under cotton was further increased to 865,259 acres, and in the succeeding year, for the first time, it exceeded one million acres—1,071,410 acres being recorded. For the second time in the history of the crop the exports in 1932 exceeded 200,000 bales, and the large increase in acreage in the 1932-33 season coupled with favourable growth conditions produced by far the record crop, 294,000 bales being exported in 1933.

In the 1933-34 season the acreage was well maintained, and although weather conditions in the early stages of the crop were marked by dry periods, the crop at the end of the year warranted an

estimate of 285,000 bales, and at the time of writing there is every indication that the crop will not be far short of this figure.

ECONOMICS OF THE INDUSTRY.—The development of the marketing and ginning of the crop in Uganda presents an interesting study. Increase of transport facilities has been mainly responsible for the evolution of the ginning industry to its present stage, and, conversely, the expansion of the cotton industry has in the main provided the wherewithal to develop Uganda's really outstanding road-system, which in the chief cotton-growing areas consists of a network of first and second class all-weather roads.

In the initial stages a large amount of human porterage was used up annually in moving the crop from up-country areas to the few railhead ginneries. At that time the crop was bought from the growers by itinerant petty buyers acting as agents for the larger firms. The first actual power ginnery was erected at Kampala in 1906 by the Uganda Company. Prior to that date the crop was dealt with by hand-gins or was ginned at the Kisumu ginnery of the British East Africa Corporation.

At first, ginneries were mainly confined to railhead at Kampala and Jinja, but later the policy of up-country ginneries was developed with a view to reducing the costs of transport, as the transport of the seed-cotton to ginneries over long distances—in many cases largely by head loads—meant that roughly two-thirds of the material carried in the seed-cotton at that time was a waste product of no economic value.

Succeeding the collection of the crop by itinerant buyers a system of open markets was devised, and so far as one can gather many plans of the type of market to be erected were considered, the object being to evolve a market lay-out which gave no undue advantage to any one buyer.

The high prices which ruled in the immediate post-war period gave a great stimulus to cotton production, and the profits which were to be made at that time led to the sinking of a large amount of capital in ginneries. In the 1914-15 season there were 20 working ginneries in the Protectorate to deal with a crop of 32,816 bales of 400 lbs. net. At the end of the Great War the figure had risen to 42 working ginneries, although the crop had remained stationary. Since that date a further 152 ginneries have been erected, and there are at present 194 erected ginneries, of which, in a normal season, about 70 are "silent," and used purely as buying centres for the purchase of seed-cotton.

The season 1918-19 saw the industry established on a sound

footing with an acreage of 143,000 acres, and in that season new Cotton Rules came into operation, providing for a system of licensed buying posts, with continuous buying in place of the open markets with fixed buying-days, already mentioned above.

It is of interest to record that in 1919 Uganda cotton was sold in Liverpool at a price of 59·15d. per lb., whilst over 50d. per lb. was frequently recorded. In some cases the premium of Uganda cotton over American "middling" reached as high a value as 2,500, and even more, points on. In 1921, however, there followed a catastrophic fall in world prices, and the buyers were not able or willing to buy all the cotton offering, so that it became necessary for Government to buy where private enterprise was not operating. This intervention, in addition to returning a handsome profit to Government, had the effect of giving confidence to the growers, who at one time were faced with the possibility of no market for their crop.

During 1923 an exhaustive investigation into the cotton industry was held, and it was decided that the maintenance of a close Government control was necessary. In order, however, that those directly concerned in the industry might have facilities for bringing their views before Government, a Cotton Board was constituted with the following functions:

(1) To advise as to the position and number of central markets;

(2) To consider and advise on applications for the erection of new ginneries;

(3) To advise, generally, on all legislation and rules dealing with the cotton industry; and

(4) To advise generally on all matters connected with the welfare of the cotton industry.

In 1925, as a result of the Board's recommendations, permanent cotton markets were established in the Eastern Province and came into operation in the 1925-26 cotton season. At these centres and at all ginneries in that Province seed-cotton could only be stored in rat-proof buildings of approved design. Permanent cotton markets were also introduced in Buganda, but at these markets the erection of permanent buildings was not made compulsory.

During 1919 a cotton tax was imposed for the first time on all lint produced within the Protectorate, and with the exception of years in which the world price of cotton was too low to warrant the imposition of a tax, this tax has been in force since that date.

In the first instance the tax was an excise tax, but later this was changed to an export tax; and after being changed from a fixed tax

per lb. of lint to a sliding scale of taxation based on the value of American "futures" in the middle of December, the basis was again changed in 1933, the rate of duty now in force being, that if the official closing price for American middling July futures on the Liverpool Cotton Exchange on December 14, 15, or 16, of the previous year (whichever shall be the last day on which business is done in respect thereof) is below 4·50d. per lb., no tax shall be payable, but if the price is 4·50d. or over, a tax of 2 cents per lb. shall be paid on all lint exported from the Protectorate in the following year.

The amount of the tax collected by the Government since its institution in 1919 totals £1,589,552. In the first year receipts from the tax were credited to a special "Uganda Cotton Development Fund," and this fund was used on special cotton development works, such as roads in the cotton areas in the Eastern, Northern, and Buganda Provinces, cotton-breeding stations at Serere and Bukalasa, cotton-seed stores, etc. After the first year the tax receipts were credited to general revenue, and the cotton development works since that date have been financed from Protectorate funds.

In 1926 a comprehensive Cotton Ordinance was enacted which took control of cultivation, marketing and ginning, and, with numerous amendments, this ordinance is still in force.

The large increase in the number of ginneries in the post-war period combined with the fall in prices to a level below that of the pre-war period, led to intensive competition and prices for seed-cotton which could only mean the barest of margins over the actual overheads of the ginning industry. This position led to various attempts by ginners to establish associations, pools, etc., and in 1929 a Commission of Enquiry into the Cotton Industry was set up under the Chairmanship of Sir William Morris Carter, Kt., C.B.E., with the following terms of reference:

> "(*a*) To frame estimates of the reasonable cost of purchase of seed-cotton (exclusive of price paid), of transport to ginneries, of ginning and baling such cotton and of transporting it to the railway, indicating as closely as possible the items comprised in these costs and the separate amounts thereof.
>
> "(*b*) Having regard to such estimates and other necessary factors, including the ruling price of Uganda cotton in the world's markets and the current price obtainable for cotton-seed, to lay down a formula for ascertaining from time to time whether a fair price is being paid to native cultivators in Uganda for seed-cotton.
>
> "And to investigate into and report:

"(i.) Whether in accordance with that formula the prices paid to native cultivators of cotton in Uganda during each of the years 1927, 1928, and 1929, were fair and reasonable.

"(ii.) Whether, and to what extent, the formation of Cotton Buying Associations has had a prejudicial or beneficial effect on the price paid to native cultivators and on the cotton industry generally.

"(iii.) Whether, and in what manner, the Government could or should intervene in an endeavour to ensure that fair prices are received by native producers of cotton."

A very full and informative report was submitted, and the Government accepted generally the conclusions of the Commission. Arising out of the Commission's report, legislation was enacted to prevent the unauthorized increase of ginning capacity of existing ginneries, and sympathetic assistance was given in the following year to the operation of Cotton Buying Associations by prohibiting the movement of seed-cotton out of the areas covered by such associations, and by the setting up of a Cotton Price Control Board which had the power to fix minimum prices for seed-cotton. Legislation was also enacted governing the employment of child labour in ginneries.

In spite of the assistance rendered by Government, however, the attempts to form associations were not completely successful, and following on this it was decided that no further assistance should be given to the formation of Cotton Buying Associations by limiting the movement of seed-cotton, and that movement of seed-cotton would be restricted only as should be required for purely agricultural reasons.

A development of considerable importance since the war period has been the ever-increasing use of motor transport in the marketing of the crop. Prior to 1924-25 the bulk of the growers' cotton was carried to the markets as head loads, but the intense competition for the crop combined with the excellent system of roads led buyers to offer transport facilities by motor lorry to the growers, and at the present time the bulk of the crop is brought to the buyer by this means. The usual charge is a shilling a bag irrespective of the distance carried, and as the most usual limit of marketing is one grower one bag, it is no uncommon sight to see a lorry laden with bags of seed-cotton as dunnage and a chattering crowd of the owners of the bags perched precariously on the top of the load careering along to realize on the product of their labours.

Whilst undoubtedly the use of motor transport is a normal development, its irrational use in increasing the collecting areas of

individual ginneries is a development which can have adverse effects on the cotton position generally. For instance, in a country where, on account of climatic and soil variations, the character of the cotton varies, intensive collection in areas near to the ginnery, as against extensive collection over an area say within a radius of thirty or forty miles from the ginnery, leads to a more uniform quality in the lint turned out. In addition, the carrying of seed-cotton over long distances and the distribution of the resultant seed from ginneries may be a potential factor in the spread of such diseases and pests as blackarm and pink bollworm.

After considerable discussion of the subject it was finally decided that, in order to minimize the evils referred to, a system of dividing up the cotton-growing areas into "quality zones" and the licensing of motor lorries for the transport of seed-cotton within those zones should be introduced, and this was done by means of the Cotton (Amendment No. 2) Ordinance, 1933. It was realized that such action would tend to encourage the formation of buying associations within the zones established, and power was given under the Ordinance to fix minimum prices.

Government realizes that, although the erection of the numerous ginneries has been largely responsible for the present satisfactory acreage under cotton, now that all the cotton-growing areas are well served in the matter of marketing of the growers' cotton, the next stage in the ginning industry should be one of consolidation and centralization with a view to a reduction in the overhead costs, and it is hoped that this first stage of zoning will lead to an attempt by those concerned to proceed further in the matter of rationalization of the industry.

With the growth of the crop it was natural that there should be developed a local market for the sale of lint, and although no official cotton exchange has yet been established, several lint-brokers have opened offices in Kampala and Jinja, and the contracts registered in most years represent considerably more than the actual crop, much of the crop changing hands two or three times prior to export. The actual export of lint is mainly in the hands of several big firms, and the small ginner finds no difficulty in disposing of his bales locally at satisfactory prices. In the earlier days of the industry the bulk of the cotton was consigned to Liverpool, but latterly an increasing amount has found its way to India and Japan. The local lint market, reflecting as it does both Liverpool and Bombay prices, fulfils a very useful function, and the local prices at which business is done form the basis of prices to the grower.

The Position of Uganda Cotton in the World Market.—Although, when compared with the world production of cotton, which approaches thirty million bales of 500 lbs. net, Uganda's production of the equivalent of less than a quarter million bales of 500 lbs. appears insignificant, it is important to remember that in the group* of cotton to which it belongs this amount is equivalent to approximately 10 per cent. of the world's production, and it is considered of sufficient importance to warrant publication of separate quotations in the official weekly circulars of both the Liverpool and East Indian Cotton Associations. In addition, Uganda now occupies, with the exception of India, the premier position as a cotton producing country within the Empire. In the latest classification of the world's cotton crops by Professor Todd, Uganda lint is placed in the second of the four groups, with other cottons with a staple of over $1\frac{1}{8}$ inches and under $1\frac{3}{8}$ inches. In this group are also included Upper Egyptian, Brazilian, Peruvian and Staple American cottons, the last named produced in the Mississippi Delta, South Carolina, etc. Uganda lint occupies a position between Egyptian and American, and its value in the world's markets reacts to price movements in each of these markets. For example, in normal years it commands a premium over American middling, but if there is a short Egyptian crop with a corresponding high price for Egyptians, then the " basis " for Uganda would widen relative to American middling.

In spinning, the use of Uganda cotton varies in the different countries to which it is consigned. In Lancashire it is used for mixing with the medium staple cottons, in Japan it is skilfully mixed with short stapled cotton, whilst in India in many cases it is spun pure.

In the early days of the cotton industry, as mentioned above, the bulk of the cotton was sold to Liverpool, but since the war the bulk of the crop has found its way to India and a proportion to Japan.

Whereas in 1915 India took 3,269 bales, or approximately 12 per cent. of the crop, by 1921 this had increased to 47,802 bales, or approximately 59 per cent. of the crop, and in 1932 almost 90 per cent. of the crop, representing approximately 180,000 bales, was exported to India.†

* *Cf.* Todd, vol. ix., 1932, p. 52.

† A small proportion of this was re-exported to other destinations.—[Ed.]

(To be continued.)

THE BIOLOGICAL CONTROL OF INJURIOUS INSECTS AND PLANTS, AND THE WORK OF FARNHAM HOUSE LABORATORY

BY

W. R. THOMPSON, Ph.D., D.Sc., F.R.S.

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It is an unfortunate fact that many of our modern problems are due to scientific discovery; or, to put the matter more fairly, to scientific discoveries imprudently applied or utilized in an incompletely scientific setting. Rapid transport, for example, has not, so far, proved an unmixed blessing to agriculture. It has made possible the immense modern development of industrialized agriculture in vast, sparsely populated areas, remote from the great centres of consumption. In a world devoid of political unity, organized mainly for profit, there inevitably results a huge unregulated production, tending rapidly to excess. As the market approaches its saturation point, competition becomes more intense, while the standard for marketable produce rises higher and higher. From this, the consumer reaps a momentary advantage; but its general effect is pernicious, because the burden on the primary producer, already hard hit by the fall in prices due to excess output, is increased by the necessity to conform to higher market standards. Furthermore, his attempt to do so creates, in many cases, new problems of a very serious order for the consumer and the public authorities.

For example, it is a matter of common knowledge that apples locally produced for local consumption in many continental centres are often markedly inferior in appearance and flavour to those imported from distant regions overseas. This inferiority is due not only to the fact that little or no attempt is made to grade the fruit or present it attractively, but also to the frequent presence of blemishes and the caterpillars of the ubiquitous codling moth. But the freedom of the imported apples from blemish and " worms " is not always or even generally due to their absence in the areas where the apples were grown. It is more often due to special treatment, particularly with various chemical sprays—insecticides and fungicides.

That certain of these chemical sprays, such as lead arsenate,

notably diminish damage by insects like the codling moth, has long been known. These treatments do not, of course, prevent recurrence of attack year after year, nor even a gradual increase of the pest; they have, however, for many years past enabled many growers to produce a marketable crop at a profit. But there are certain areas where satisfactory crops can only be obtained by repeated applications of the poisons; and it seems that in some districts growers are being forced to spray more and more frequently as time goes on. This is, perhaps, due simply to the raising of the market requirements, though it may be due also to a gradual increase in the population of the pest or, perhaps, as has several times been suggested, to the appearance of races partially immune to the poisons used. At all events, the generalization and increase of spraying programmes has gradually focussed attention on another problem connected with this work—the very serious problem of what are called spray residues. Entomologists and authorities responsible for the health of the public are coming to realize more and more keenly that the application to substances destined for human consumption of large quantities of toxic materials may entail serious dangers, particularly marked in the case of lead compounds, because they tend to accumulate in the organism, so that after a very slight lead intake for five, six or seven years, serious symptoms may suddenly set in. Certain new insecticides, such as fluorine, mercury in various organic combinations, and selenium, whose compounds tend, it is said, to enter the plant metabolism and replace sulphur in the harvested crop, may also be very dangerous to health under certain conditions. The public authorities in some countries have therefore found it necessary to impose a limit to the residue of toxic material left on sprayed fruit and vegetables placed on the market. In order to conform to these regulations, the sprayed material must be thoroughly washed, which necessitates the installation of special apparatus, expensive to purchase, operate and maintain. The costs of production are thus increased and, in spite of the efforts made to enforce and keep the law, one may still wonder whether all danger to health has been eliminated, and continue to prefer fruit on which no poisons have been used to fruit from which poisons have been washed off, be the washing never so elaborate.

It is probably true that the attempts made in some parts of the world to raise food for distant markets are economically unsound; and that in some of these cases the liability to insect and fungus attack is one of the most serious obstacles to success. On the other hand, it would be practically impossible to confine the production of economic plants and animals to regions in which insect and fungus

attack are negligible. Some of the major pests of many important crops have now been distributed over almost the whole area in which these crops are grown. Furthermore, the normal practice of reserving particular areas for particular animals and plants tends of itself to provide conditions suitable for pests. Natural environments normally support a large number of species of plants, mingled together. Individuals of a species suitable as food for any given pest are scattered here and there over the area; some therefore escape infestation, while others may be so heavily attacked that the colony of the pest eats itself " out of house and home." Furthermore, there are many beneficial insects whose maintenance is primarily dependent on a diversified flora.

Thus, in spite of its many admirable features, the large-scale clean agriculture of modern times has some disadvantages. It would perhaps be futile to suggest as a remedy the return to more primitive or more diversified systems. Organized world planning, that dream of some modern economists, may eventually enable us to reap the rewards of large-scale agriculture and evade the catastrophic effects of overproduction. Further investigation may produce insecticides which are cheap, effective against pests and yet definitely innocuous to human beings. In short, the solution of our agricultural problems may be secured, not by a return to partially primitive conditions, but by a more intelligent utilization of our technical resources.

Nevertheless, under present conditions, it is almost impossible for primary producers to introduce any new methods, materials or apparatus entailing an increase in the costs of production. For the moment, at least, it seems wiser to explore and employ procedures of a more natural and, therefore, a less costly character. Of these, one of the more important is the system of combating the pests of animals and plants by utilizing their natural enemies, the predaceous and parasitic insects, now generally known as the method of Biological Control.

The basis of the method of biological control lies in the fact that many of the important insect and plant pests are partly held in check in their natural environments by other insects that prey upon them, having, in many cases, a specific affinity for prey of a particular type. When an economic plant or animal is transported to a new country, its insect enemies are sometimes carried with it, but the natural enemies of the pest are often left behind. Occasionally, a plant brought into a new country acquires new enemies, which migrate to it from their original native food-plants. The extensive mass of food provided by a cultivated crop permits the pest to increase in numbers. Even

under these conditions it is usually controlled to some extent by the natural enemies which accompany it to the new food-plant. If, however, it succeeds in migrating without these enemies to the original home of the new food-plant, it may do very serious damage. Several of these curious cases are known. For example, maize is a plant of American origin. It is generally supposed to have been brought to Europe after the discovery of America by Columbus, and though St. Rose of Viterbo says in her writings that it was brought to Spain by the Arabs in the thirteenth century, it is certainly not a native of the Old World. One of the principal insect pests of maize in Europe is the larva of a pyralid moth, the European Corn Borer (*Pyrausta nubilalis*), which mines in the stalks and ears of the plant. This insect lives, in Northern Europe, on various native weeds, such as Mugwort (*Artemisia vulgaris*), and presumably migrated from these native weeds to maize. It is a common insect in the maize-growing areas of Europe, but seldom does serious damage excepting in certain parts of Central Europe, being kept in control by a variety of environmental factors, including a large number of parasitic insects belonging to several groups.

About fifteen years ago the European corn borer was, however, accidentally transported to the North-eastern States of America. It rapidly increased in numbers and became so destructive that a few years ago the United States Government actually expended a sum of £2,000,000 in the effort to check its advance. This unprecedented increase in destructiveness seems to be due in part, at least, to the fact that none of the European insect enemies of the corn borer accompanied it to its new home.

A very similar case is that of the woolly aphis of the apple (*Schizoneura lanigera*), commonly known as American Blight. Several species of the genus to which the apple belongs are natives of North America, but the apple (*Pyrus malus*) itself is an introduced species. After its establishment in America it was attacked by the woolly aphis, which has since spread over almost the whole area in which apples are grown, leaving behind it one of its most important natural controls, the chalcid parasite, *Aphelinus mali*.

In the same way, the spread of cotton insects to the various parts of the world devoted to this crop has caused extremely serious losses. The pink bollworm, which seems to be an insect of Indian origin, has now established itself in most of the cotton-growing countries where it often causes great damage. In 1892, one of the most serious of all cotton insects, the American Boll Weevil (*Anthonomus grandis*), originally a native of the plateau region of Mexico and Central America, crossed the Rio Grande into Texas and spread steadily from there

onward throughout the Cotton Belt, where it causes an annual loss amounting to from 10 per cent. to 30 per cent. of the crop.

In such cases, the introduction into infested areas of the natural enemies of the pest in its native home has become a recognized department of entomological practice. Furthermore, it is now known that for various reasons, such as sudden temporary changes in the weather, or the exhaustion of food supply, a beneficial insect may suddenly disappear from extensive areas in which it normally occurs, allowing the host to become destructively abundant, and that in such instances the reintroduction of the beneficial species from adjacent areas may be distinctly profitable. Finally, it may be possible to devise measures to keep the population of parasites and predators of certain pests at a permanently high level, either by judicious management of the environmental factors or by the addition of individuals reared in the laboratory.

Extensive operations along these lines have been carried out in various parts of the world. Within the British Empire work in biological control has not until quite recently been as actively pursued as in some other countries, principally because of the inadequate development of the entomological services, due in turn to an insufficient appreciation of the losses caused by injurious insects and weeds. In 1927, however, the Imperial Institute of Entomology, with the help of funds from the Empire Marketing Board, founded at Farnham Royal, near Windsor, a laboratory designed to serve as a centre for work of this kind within the Empire. The entomologists of the Dominions and Colonies were invited to use the resources of the laboratory and submit projects for study. Their response showed that the laboratory met a real need in imperial entomology. Up to the present about 40 pests have been investigated on behalf of various Empire Governments, and over 360 shipments of beneficial insects, comprising over two and a half million specimens, have been sent to different parts of the Empire. The table on p. 185, which includes the projects dealt with by entomologists of the Australian Council for Scientific and Industrial Research, which makes Farnham Royal its headquarters for entomological work in Europe, summarizes what has been accomplished up to the present time.

To give an idea of the procedure followed in the work we may take the case of the wheatstem sawfly. This pest is the most serious enemy of wheat in the Western Provinces of Canada, and heavy infestations have occurred repeatedly. In 1926 the loss in Saskatchewan alone was estimated to be about £2,400,000. The sawfly is a native of Canada, but it has in the wheat fields no effective parasites.

Country.	*Shipments Made.*	*Insects Shipped.*
Canada	74	945,421
Australia	82	291,165
New Zealand ...	114	1,272,758
South Africa ...	3	6,500
India	3	4,700
Kenya	2	2,000
West Indies ...	8	10,103
Falkland Islands...	1	319
Fiji	1	634
Great Britain ...	58	53,587
Irish Free State ...	3	5,600
Northern Ireland	1	1,600
Ceylon	3	31,000
Foreign States ...	11	20,375

In Europe it does not exist, but has a very close relative with similar habits. A preliminary study of the problem suggested that the parasites of the European species might be effective against the Canadian pest, and in 1929 an extensive survey of the principal wheat-growing areas in England was made. The sawfly was found to be widely distributed but nowhere abundant, owing to the control exerted by a complex group of parasites. A careful study eventually showed that the control of the insect was mainly due to one of these parasites, a curious parasitic wasp, *Collyria calcitrator*. Sample collections of material from wheat fields enabled us to select those in which both pest and parasite were most abundant. Arrangements were made to secure the stubble from these after the harvest and this was transported to the laboratory, where it was dried, cleaned and sorted during the course of the winter. In 1930, as a result of this work, 15,000 cocoons, of which a large proportion contained parasites, were shipped to Canada where the beneficial species was eventually reared and distributed the same year in the infested fields of the Western Provinces. The work was continued in subsequent years and in the winter of 1933-34 over 337,000 cocoons were collected and shipped, a task entailing the detailed examination of over 500 large sacks of wheat stubble and requiring the labour of eight special workers for a period of about six months. As a result of these shipments many thousands of parasites were liberated in the Western Provinces, where they have successfully attacked the Canadian pest and have now become definitely established.

Occasionally it is possible to produce large stocks of parasites for export by breeding them in the laboratory. This was the method followed with a parasite of the cabbage white butterfly, a very injurious insect recently introduced into New Zealand. A small stock of the parasite was obtained from chrysalids collected in the field.

These were then bred throughout the winter on chrysalids of the cabbage white kept in cold storage and removed as required, and in this way about 40,000 specimens of the parasite were eventually obtained for shipment. In most cases, however, the complications involved in breeding work make it impracticable and it is found best to rely on direct collections in the field.

The number of beneficial insects introduced in some of the cases mentioned seems large. In reality it is extremely small compared to the population of the pest in the infested area. A considerable period may therefore elapse, especially in temperate climates, where the generations succeed rather slowly, before the parasite is able to catch up with the pest and produce an economically measurable effect. Nevertheless, the work of Farnham House Laboratory has already produced some technical and practical successes. The parasites of the greenhouse white fly, of the sheep blowfly, of the sirex wood wasps, of the pear midge and of the cabbage caterpillars have already been established in New Zealand, together with some of the insect enemies of gorse and ragwort, which rank as noxious weeds in that Dominion. Parasites and predators of the pine shoot moth, the pine chermes, the wheatstem sawfly and a Lecanium scale of shade trees, have been established in various parts of Canada. The last-named insect was so abundant in the city of Vancouver, B.C., a few years ago, that the shade trees were threatened with destruction. The parasite introduced has now reduced its numbers almost to the vanishing point and has made it possible for the local authorities to dispense with the expensive artificial methods of control hitherto employed. Some very successful introductions have also been made in the West Indies by Dr. J. G. Myers, a member of the laboratory staff engaged in biological work in that area.

Up to the present no very satisfactory successes can be claimed for the method of biological control in relation to insects attacking cotton. This no doubt depends in part on the fact that some cotton insects are relatively inaccessible to parasitic attack and have in some cases few natural enemies of any importance. But it may also be partly due to an insufficient exploration of the possibilities of the method, indicated a number of years ago in regard to cotton by Dr. Myers in an article in this Review. For example, several parasites of cotton stainers (Dysdercus), which seem to exert considerable effect under certain conditions, are known to exist in Queensland and might be extremely valuable against the stainers in other areas where they are troublesome. Again, no really adequate attempt to attack the pink bollworm from this standpoint has yet been made, in spite of the

widespread distribution of the pest and the severe damage it causes in many countries. The method of biological control has, of course, its limitations. It is not a universal panacea, and there is no reason to believe that it will ever supersede all other methods of controlling insect and plant pests. But its possibilities have not yet been adequately explored, much less exhausted, and it is of exceptional interest at a time like the present, when economic pressure is making it increasingly difficult for the planter to employ more immediate but more costly methods of artificial control.

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STUDIES ON BLACKARM DISEASE OF COTTON—III

BY

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SINCE the last paper was published in the EMPIRE COTTON GROWING REVIEW (Vol. VIII., No. 3, July, 1931) more exact knowledge of the phenomena underlying the development of Blackarm disease of cotton has been obtained, both in the laboratory and in the field.

The present article reviews very briefly some of the salient features of the investigations, in so far as they concern the practice of cotton growing under irrigation in a heavy clay cotton soil. It is hoped, however, that our experience may be of use to cotton growers under rainfall conditions.

I.—THE INFLUENCE OF SOIL MOISTURE ON THE DEVELOPMENT OF PRIMARY OR SEED-BORNE INFECTION.

When the soil temperature is maintained between 25° and 30° C. (77°-86° F.) an increase in soil moisture up to 40 parts of water to 100 parts of dry soil results in an increase in percentage germination, but also in an increase in disease. More water retards germination, and at 50 parts of water to 100 of dry soil not only is germination adversely affected, but the percentage of Blackarm also decreases owing to the rapid disappearance of the causal organism (see later).

II.—THE EFFECT OF SOIL TEMPERATURE ON THE DEVELOPMENT OF SEED-BORNE INFECTION.

The view has been consistently held in these laboratories that the chilling of the soil by rain during the early stages of germination is the most important aspect of soil temperature, and recent experiments have shown that maximum infection is obtained when the soil temperature is reduced sometime between 24 and 48 hours after sowing.

Chilling the seed-bed with iced water produced no increase in the number of diseased seedlings 72 hours after sowing, and no reduction in infection was obtained by raising the soil temperature 2 days after sowing. It has been observed in the Gezira that a rainstorm will temporarily reduce the temperature of the surface soil from 30° C. (86° F.) to 20° C. (68° F.), and, of course, at the same time the water content of the soil is increased.

III.—The Critical Stage in Seed-Borne Infection.

In the article referred to above the existence of a bacteriophage in river water and in the soil of plots that had borne an infected crop of cotton was reported. Recent work has confirmed this finding and has shown that *B. malvacearum* disappears in wet Gezira soil within 72 hours, and has also shown that when Gezira soil is added to cultures of the organism the smooth pathogenic form is largely transformed into the rough form, which is either not pathogenic or only feebly so.

It would appear, therefore, that in order for infection to take place the parasite must gain entrance into the tissues of the germinating seed within this period. Once entry has been effected the conditions required for the development of the disease are much less specific, and in practice it is found that after the critical period neither changes in soil moisture nor in soil temperature greatly affect the progress of the parasite.

It will be clear from the above that considerable control of seed-borne infection can be obtained by attention to the seed-bed. It has been demonstrated repeatedly in this country that a healthy crop can be raised from infected seed, but nevertheless the arguments for seed disinfection are overwhelming, since it has proved to be well-nigh impossible to guarantee clean seed wherever Blackarm is endemic.

IV.—Seed Disinfection.

The practice of seed disinfection has become almost universal in this country. Home-made machines consisting of 40-gallon oil drums slung diagonally on a horizontal axle supported on trestles, and turned by hand labour, have proved cheap to make and efficient in use. At the time of writing 20 such drums are dusting 600 sacks of seed, each containing 270 lbs. of seed, in 5 hours. The addition of a little water to the seed in the drum during dusting has been found to improve the ease of operation.

V.—On the Spread of Angular Leaf Spot and Blackarm in the Field.

The dissemination of *B. malvacearum* E.F.S. by rainstorms has been accepted for many years. It was, however, of great interest to us to ascertain whether any spread of Blackarm disease might be expected outside the period of heavy and constant rains, and to watch the progress of the disease during drier and hotter conditions than prevail during the rainy season. For this purpose plants were sprayed at the Plant Houses, where the environmental conditions could be modified at will.

It was found that lesions were formed even in the open, where the relative humidity was only 25 per cent., provided that the spray used was sufficiently powerful to overcome surface tension, and to wet thoroughly the surface of the leaf. It was, of course, necessary that the stomata should be open, but no closure was detected during the day whilst the experiments were in progress.

The lesions thus formed were usually small and developed slowly, moreover the incubation period was prolonged to 10-12 days. The shade temperatures at the time of spraying were: maxima about 33° C. (91·4° F.), and minima about 16° C. (60·8° F.).

As might be expected, larger and more characteristic lesions were always obtained under more humid conditions; also with relative humidities of 60-75 per cent., and temperatures ranging from 40° C. (104° F.) to 30° C. (86° F.), the incubation period was frequently reduced to 3 days. Partial water-strain facilitated the entry of the parasite, but progress of the disease was naturally restricted. The highest percentage of active lesions was obtained on healthy and rapidly growing plants with large leaf surfaces.

No true immunity was ever detected amongst Egyptian cottons, but whenever the environmental conditions became unfavourable to the parasite, strongly growing plants recovered to a very considerable extent.

Senescent tissues or leaves thickened by the Leaf Curl virus were much more resistant to infection than young rapidly developing tissues, in fact on the same plant gradations in susceptibility were often found. Stem infections—*i.e.*, the true Blackarm form of the disease, occurred only in very young tissues, and were derived primarily either from a leaf via the petiole, or from an axillary bud.

No evidence of the spread of the disease except in association with moisture has ever been found. Dry infected particles and dormant bacteria lying on the surface of leaves may, of course, be

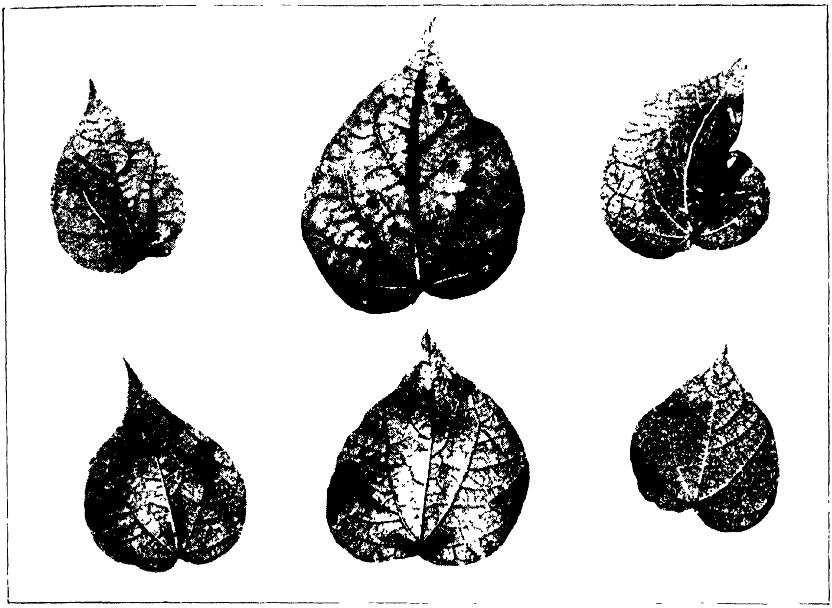

FIG. 1.

Top row : Confluent lesions obtained at high humidities on young leaves.
Bottom row : Lesions obtained at low humidities on young leaves.

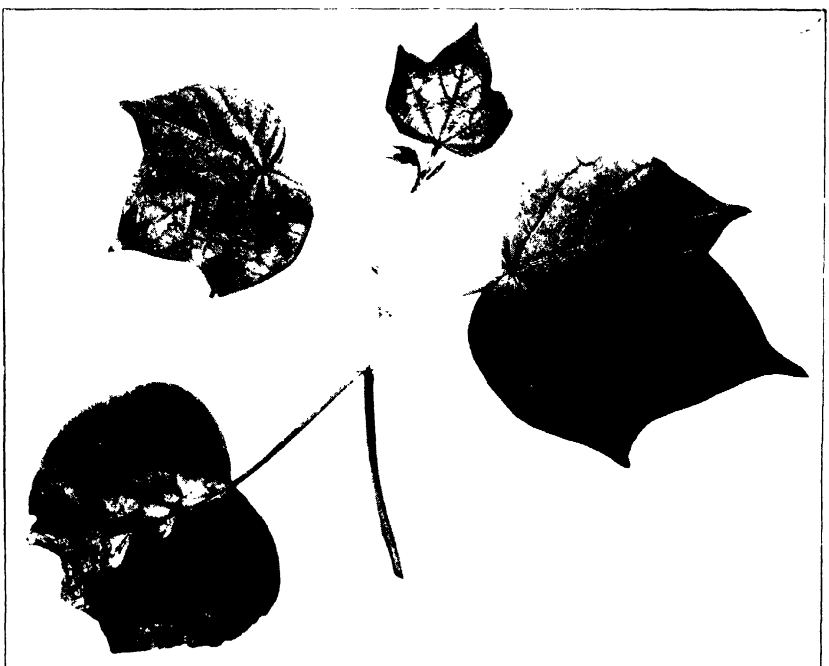

FIG. 2. DEVELOPMENT OF BLACKARM PHASE ON STEM FROM LEAF LESION.

activated by dew, also infection may take place by contact under humid conditions whilst the lesions are fresh. This is frequently seen when young bolls are infected by the sheathing bracts on which are lesions resulting from rain infection.

VI.—Requirements for Successful Infection by Spraying.

Experiments have indicated clearly that entry of the stomata takes place when the leaf surface is thoroughly wetted, and a continuous film of moisture exists within which the bacterium is drawn into the substomatal cavities, and thence into the deeper tissues. In complete darkness practically no infection takes place, provided that sufficient time has elapsed for all the stomata to close. Stomatal movements were found to be slow and progressive, and to be partly arrested by feeble illumination such as moonlight.

It is worth recording one result in which spraying of 25 plants in moonlight resulted in the formation of 301 lesions, whereas spraying by starlight gave 5 lesions only on a similar batch of plants. Stomatal movements were checked by a self-recording porometer. Motility of the bacteria is not necessary, as water appears to be drawn into the stomata by physical forces. The liberation of the bacteria from a fresh lesion is practically instantaneous, and under suitable conditions the entry of the parasite into a fresh plant is similarly a matter of moments only.

Temperature directly affected the intensity of infection, many more lesions being obtained with a warm spray 32° C. (89·6° F.) than with one cooled to 10° C. (50° F.). Should the leaf surface dry before the organisms gain entrance they can remain dormant on the surface for a lengthy period, possibly as long as the leaf is alive. Fully expanded leaves gathered from an infected plot have been found to hold 44 millions of *B. malvacearum* per leaf, mainly on the upper surfaces.

No secondary host of *B. malvacearum* has been found in the Sudan, and it is a curious fact that *B. malvacearum* has never yet been isolated from the surface of weeds growing within a cotton plot bearing Blackarm lesions.

No evidence whatever has been found for the transmission of Blackarm disease by insects commonly found feeding on cotton. Flea beetle, jassids, whiteflies have been removed from infected plots on to healthy cotton without effecting transmission, also better controlled experiments in cages have been conducted without success.

VII.—The Persistence of *B. malvacearum* in Nature.

As the interval between successive crops of cotton in the Sudan is normally less than four months, the survival of *B. malvacearum* in the field is of the utmost importance, particularly as the cotton of two successive seasons may be adjacent.

(*a*) *In Soil.*—*B. malvacearum* has never been isolated from the soil of the seed-bed except in connection with infected plant remains. Soil which has been artificially infected with plant débris and afterwards reduced to fine powder, as happens on roadways, has been found to be innocuous after three months' exposure in the open.

(*b*) *In Water.*—In raw river water *B. malvacearum* disappears after 72 hours, and during the flood period an active bacteriophage can be isolated from the turbid Blue Nile water. Similarly, in irrigated soil the life of the organism is equally short. In rain or distilled water it has been known to survive a month.

(*c*) *In Plant Remains.*—Dry woody tissues will retain the organism in a viable condition for a long period. Alternate wetting and drying fails completely to sterilize such material unless frequently repeated.

More fragile tissues such as leaves and bracts when reduced to powder lose their infectiousness within four months. Such material derived from infected plants and distributed by wind may assume importance should the rainy season be prolonged. The finer particles adhere to the surface of leaves, and are only completely dislodged by the heaviest rains. A thorough soaking is necessary to activate the parasite contained therein, but as rains tend to be less violent towards the end of the season the necessary conditions for the liberation of the organism and its entry into the healthy tissues on which it rests frequently occur.

Fallen bolls containing infected seed cotton are a particularly dangerous source of carry-over, as germination of the enclosed seeds may be delayed until the new crop is established.

The extent to which infected débris from the previous season becomes a source of reinfection depends on the incidence and intensity of the rainstorms. In the flat Gezira plain it is found that storms of 1 inch and over are required to liberate the organism from fallen débris lying on the fallows. These storms are often torrential in character and are accompanied by strong winds which drive the infected rain spray in their path. Infection has been traced for 250 metres, but in a growing crop the most serious damage is done at short range, and it is the survival of the organism on last season's fallows adjacent to the new crop that has mainly engaged our attention.

Field experiments in which the soil was thickly covered with infected plant remains and subsequently flooded have proved that under irrigation the survival of the disease between seasons can be very considerably controlled, and at the moment of writing large areas in which Blackarm has been serious in the past are being flooded for four days as a practical test. Furthermore, to obviate the danger from floating débris, cotton stalks and other fragments of the old crop are being swept together and burnt.

The grazing of the cotton plants at the end of the crop may be of value in decreasing the amount of diseased material, since *B. malvacearum* does not survive passage through the alimentary canal of goats, but the fact that small twigs are broken off and lie on the ground should not be forgotten.

In conclusion, more detailed information of the work on which the present article is based will be found in the Annual Reports of the Gezira Agricultural Research Service issued by the Sudan Government since 1932.

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THE CYTOLOGICAL STUDY OF COTTON AND ITS RELATIVES

BY

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WHEN the first steps in genetics were taken, early in the present century, breeding methods alone were regarded as adequate for the solution of the problems of heredity and variation among plants. But as early as 1907 important discoveries were made regarding changes in the number of chromosomes from one form to another. The chromosomes, or structural contents of the nucleus, which are carefully divided lengthwise in cell division, were already recognized in a general sense as mainly concerned with heredity, but since that time our knowledge of the relation between the chromosomes and heredity has grown enormously, until now some of the smallest visible details of chromosome form and structure can be correlated with certain definite features of the inheritance.

These structures are, of course, extremely minute, and are often near the limits of observation with the highest powers of the microscope. The experimental evidence which associates not only each chromosome but each element of a chromosome with a definite hereditary unit has become so strong that few biologists now attempt to question it. This evidence began with the study of plants which had received an extra (whole) chromosome through natural but exceptional processes in the mother plant. It has extended to the experimental production of organisms with additional *fragments* of chromosomes by means of treatment with X-rays. Even before this was done, the gene* theory of heredity had been developed. According to this theory the rod-shaped chromosomes are to be regarded as containing a string of differentiated elements along their length, each

* The term gene is used to represent a difference in some character, which is inherited as a unit according to the Mendelian rules of inheritance. Two related strains may differ, for example, in the colour of their flowers or in the presence or absence of a spot on the petals, or in the shape of their leaves. Such genetic differences are recognised as having arisen through a mutation or sudden germinal change, which appears to have taken place in the first instance in a particular portion or locus of a chromosome. Such mutations form the raw material out of which evolution or the origin of new forms may be expected to take place.

of which affects the expression of a particular character, and this theory has been substantiated through the investigations of genetical crossing over.* At the same time the law was discovered that the number of linkage groups† of hereditary factors in any species corresponds with the number of pairs of chromosomes. This law, which again linked the phenomena of heredity fundamentally with the chromosomes, has important results in practical breeding. Views still differ greatly as to how genetic differences are represented in the chromosomes—in other words, as to what genes are, what parts of the chromosome they occupy, and how they produce their effects in development. But it appears to be no longer possible to doubt that such a relationship exists.

The study of chromosomes, their structure and behaviour, has thus become one of the most fundamental parts of the study of genetics. It is, moreover, not merely of theoretical importance but of the greatest practical value. Cytology, or the study of cell-structure, and genetics, or the study of hereditary behaviour, as the two complementary aspects of practical plant breeding, have become so inextricably interwoven that one cannot be profitably carried on for long without the other. The term cytogenetics is now frequently used for such combined investigations looking to the elucidation of breeding phenomena. Without high-power microscopes and the knowledge of chromosomes which they have brought, plant breeding would long since have reached its limits and have been reduced to purely empirical and rule-of-thumb methods, and the analysis of the more complicated relationships in genetics would have been impossible.

* Crossing-over may be explained as follows: Suppose a variety of plant having petals with a red colour and a white margin, while another variety has pale petals without a white margin. If in the F_2 generation from a cross between these varieties, the offspring are mostly like one original parent or the other, then the genes for red petals and white margin are said to be linked and they will be located in the same chromosome. But there may be a certain number of F_2 plants with pale petals and a white margin or with red petals and a coloured margin. These will be spoken of as cross-overs, and are believed to be due to an exchange of chromosome segments containing the relevant genes, which has taken place in the particular pair of chromosomes containing those two pairs of genes.

† It has been found, for instance, that in a species with four pairs of chromosomes all the mutations or Mendelian differences, although they may number hundreds, will fall into four linkage groups, and any new mutation discovered will be found to be linked with varying degrees of intensity to the genes already known in one of these groups. Similarly, in a species with seven pairs of chromosomes all the known Mendelian differences are found to fall into seven linkage groups. In the best commercial cottons, where there are 26 pairs of chromosomes —a relatively high number—genetic linkage will thus be less frequent than in plants or animals with a low number, because such Mendelian differences as are known will be distributed among a larger number of independent chromosomes.

All economic plants are now being studied cytologically as well as genetically, because the chromosomes furnish the basis of modern genetics. They yield valuable information as to the kind of breeding results which may be expected from certain crosses, and they give important clues and explanations of many aberrant breeding phenomena. Indeed, it has become necessary, as soon as any unexpected or unusual breeding behaviour is discovered, to examine the chromosomes in order to determine the direction in which an explanation is or is not to be sought. Many such cases have been directly explained by study of the chromosomes. In particular, a knowledge of their numbers and behaviour in related forms is necessary for the explanation of many genetic results. It has become hazardous to proceed far in any complicated genetical problem without examining the cytological side.

Plants differ characteristically from animals in that the chromosome numbers, especially of the flowering plants, generally run in multiples of some fundamental number. Thus the various species of wheat have 14, 28 and 42 chromosomes, 7 being the basal number. Their numbers are thus $2n$, $4n$, $6n$. The same is true of oats. Russian investigators have recently shown that the wild species of potato in the Andes of South America have 24, 36, 48, 60 and 72 chromosomes, all multiples of $n=12$. This condition is known as polyploidy and is characteristic of most of our cultivated economic plants. The original condition is that with two sets of chromosomes ($2n$), from which the higher multiples have been derived. Generally the most valuable species or varieties economically have the higher chromosome numbers, and in many cases they have been produced under conditions of cultivation. Russian investigators have recently produced a cabbage with twice the ordinary chromosome number by inducing regeneration from the cut stalks. This autotetraploid,* they find, is not only larger but more juicy. The cultivated sugar canes have very high chromosome numbers. Some pineapple varieties are shown to be triploid ($3n=75$ chromosomes). The same is true of many of our best varieties of apples. They have $3\times17=51$ chromosomes, while other varieties have 34. The pollen of the triploid varieties is mostly sterile. In normal pollen formation the corresponding chromosomes always unite in pairs and afterwards separate, so that each pollen grain ultimately gets only one member of each pair. But in hybrids this pairing is frequently irregular, because the chromosomes which should pair are not so nearly related. In

* By this term is meant an organism which has four sets of chromosomes ($4n$) through a doubling of its original two sets.

a triploid plant there will be three of each kind of chromosome. Two of them will pair, leaving the third set of chromosomes without mates. The latter are irregularly distributed to the pollen nuclei and thus produce an unbalanced condition in which most of the pollen grains fail to develop. The triploid apple varieties are, however, reproduced from cuttings, so that the characters of these varieties remain for the most part constant. There is evidence that the cultivated tobaccos arose through crossing of different species, followed by doubling of the chromosomes in the hybrids. A great deal of the breeding behaviour of all these plants would therefore be quite unintelligible without a knowledge of their chromosomes.

One of the most valuable methods of producing new economic plants, and one which has as yet been but little used (consciously) by man, is that of crossing two rather distantly related species or even genera, thus producing a sterile hybrid which occasionally doubles its chromosomes, as mentioned above. Such a form, having all its chromosomes in pairs, is fertile and will serve as a new centre of stability. It is known as an allopolyploid because its chromosome sets have been derived from two different sources, whereas a simple doubling of the chromosomes in any form without previous crossing is known as autopolyploidy because the chromosome sets are all alike. Allopolyploidy in one form or another has been concerned in the origin of tobacco, our bread wheats and our best cottons. It is now known that various new species have arisen in this way in nature. Skovsted has shown that the pink horse-chestnut, *Æsculus carnea*, has resulted from doubling of the chromosomes in a hybrid between two other species, the chromosomes of the original parents being recognized by their markedly different size. Similarly, Huskins has shown that the rice-grass, *Spartina Townsendii*, which spreads so rapidly on parts of our southern coast, is an allopolyploid, having arisen from a cross between an English and an American species having quite different chromosome numbers. A number of other cases of equal interest and importance have recently been discovered, and there is no doubt that this principle will be of great practical importance in the future production of economic plants.

Enough has now been said regarding these recent principles of plant breeding to furnish a background for consideration of the present problems of cotton genetics. It may be worth while pointing out here that the essential difference between plant breeding and plant genetics is that the former considers only the immediate problems and endeavours to produce better varieties at once by the application of knowledge already available; while the latter takes a wider point

of view, endeavouring to discover the principles which have been concerned in the evolution of the genus of plants in question and to apply those principles to the production of new forms. There is, of course, no sharp line between one method and the other. In the long run the wider method of approach is bound to produce much more valuable economic results, but it must always be combined with the methods of plant breeding which seek immediate though less far-reaching results.

In 1924, Denham counted the chromosomes in a number of species and varieties of cotton, and drew the interesting conclusion that while the Asiatic and African cottons have 26 chromosomes, the American species have 52, and are thus tetraploid, 13 being the basic number. No other genus is known in which such a relationship between the Old World and New World species exists. It obviously requires an explanation, and the question immediately arises as to how the valuable American cottons acquired their double number of chromosomes. The situation has recently been complicated, however, by the more recent discovery that the wild species *Gossypium Harknessii* and *G. Davidsonii* from the arid peninsula of Lower California, as well as *G. lanceoforme* from Arizona, which was formerly placed in a separate genus, are diploid, having 26 chromosomes like the Asiatic species. Davie has therefore suggested that tetraploidy may have arisen from crosses between such diploid American species.

That the tetraploid American cottons with 52 chromosomes are allopolyploids—*i.e.*, that they have resulted from chromosome doubling in crosses between different diploid species—is highly probable, and this conclusion has been independently reached by Skovsted and by Davie. But several further questions immediately present themselves. What were the parents of these hypothetical crosses? Are all the tetraploid cottons descended from one such cross, or have different crosses led to different tetraploid species? And were the parental diploid species Asiatic or American, or both? Also, did these crosses arise prehistorically or only in post-Columbian times? On the basis of certain chromosome measurements, Skovsted has recently suggested that one of the parental species of the tetraploid American cottons was Asiatic and the other a New World species with smaller chromosomes. When the differences in chromosome size are not large enough to detect them with the eye it is very difficult, however, to prove their existence by measurements, so the present results on this point may be regarded as somewhat inconclusive.

There remains the possibility that the tetraploid cottons may have

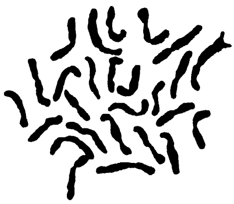

FIG. 1.

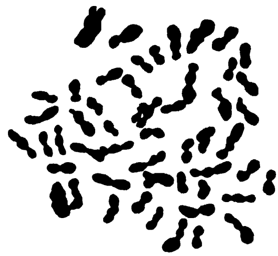

FIG. 2.

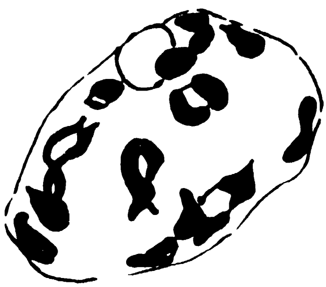

FIG. 3.

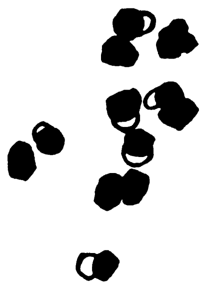

FIG. 4.

FIG. 1. SOMATIC CHROMOSOMES (26) OF *Gossypium herbaceum* (LEVANT COTTON).

FIG. 2. SOMATIC CHROMOSOMES (52) OF *G. hirsutum* (AMERICAN UPLAND COTTON).

FIG. 3.—POLLEN MOTHER CELL NUCLEUS OF *G. herbaceum* SHOWING THIRTEEN CHROMOSOME PAIRS.

FIG. 4.—A LATER STAGE, SHOWING SECONDARY PAIRING OF THE THIRTEEN CHROMOSOME PAIRS IN *G. herbaceum*.

Magnification in all cases about 3,340 diameters.

originated through crosses between diploid American species. Moreover, such crosses might have occurred naturally and led to the evolution of tetraploid wild cottons, or they might have occurred and been selected by the Indian aborigines while in a state of primitive agriculture. It appears certain from known records that large quantities of cotton were grown by the natives both in Central America and Peru before the discovery of America by Columbus. Were these tetraploid cottons, or have they perchance developed since, after Old World cottons had been introduced into America from Asia or Africa? Although the early history of the cultivated American cottons between the Discovery and the eighteenth century is so chaotic and so difficult to trace to the extent of identifying the types even approximately, it should not be impossible from combined historical and genetical data to get some evidence as to the course of events. Did tetraploidy arise only after the introduction of Old World cottons into America, or had it arisen much earlier, from crosses between American species either in the wild or under conditions of aboriginal cultivation? In this connection it may be remarked that *G. herbaceum* was apparently the first Old World cotton taken to the United States "well into the seventeenth century." A cotton was introduced from Barbados into the U.S.A. in 1664, but Sea Island ($4n$) cotton appears to have become known first in the middle of the eighteenth century. One might remark, as bearing further on this problem, that if tetraploidy could arise from crosses between different American species there appears to be no reason why it should not have arisen also in crosses between Asiatic species, but this appears never to have occurred. The Asiatic species might, however, be too nearly related for a cross to produce this effect.

Having discussed these questions relating to the origin of tetraploidy in cotton, we may now pass to certain problems bearing on the origin of the genus Gossypium itself. Here the work of Davie is of interest. It is now recognized that secondary pairing of the chromosomes is a sign of earlier homologies and a means by which evidence can be obtained as to how new chromosome numbers have arisen. By secondary pairing is meant that the chromosome pairs are themselves arranged in pairs, thus indicating mutual attraction and therefore homology. Now the basal or haploid number of chromosomes in Gossypium is 13, a peculiar number found in relatively few families of plants, although it occurs in six genera of the Malvaceæ, the family to which cotton belongs. Seven, a much more common and widespread basal number in plants, occurs in *Lavatera trimestris*, and

higher multiples of 7 occur in certain species of Hibiscus. In the genus Malva, also related to cotton, all of the eight species so far examined probably have 42 chromosomes, and are therefore hexaploid ($6n$) in relation to the number 7. Numerous species remain to be examined, and some of them may prove to be diploid, or it may be that the genus is now composed only of hexaploid species, the lower members of the series having become extinct.

It thus appears that the genera nearly related to cotton have 7 chromosomes as their basal number, and that when the genus Gossypium originated this number was in some way changed to 13. Skovsted has suggested that this may have come about through crossing between genera having respectively 6 and 7 chromosomes as basal numbers; while Davie suggests that it has probably come about by end-to-end fusion of certain chromosomes in an allotetraploid with 28 chromosomes, thus producing a hypotetraploid with $4n-2=26$ chromosomes. Both Denham and Davie have found evidence that one pair of chromosomes in the Asiatic cottons and two pairs in the New World cottons are longer or larger than the rest. There is evidence in other plants and animals that such fusions do actually take place. According to Davie's view the so-called diploid or Asiatic cottons are therefore really modified tetraploids, and the American cottons, commonly spoken of as tetraploid, are in reality modified octoploids. That is to say, the 26 chromosomes in Asiatic cottons represent four sets of seven less two, because two pairs of chromosomes have joined end to end to form each one pair. If, at a later period, a hybrid between two such species doubled its chromosomes, there would then be 8 sets less two pairs—*i.e.*, 52. These modified octoploids ($8 \times 7-4=52$) might, therefore, be expected to have as many as eight representatives of certain of their genes in the full set of 52 chromosomes.

It may be pointed out that there is already genetic evidence of the presence of multiple factors,* and hence of a polyploid condition. For instance, Harland has found in several experimental crosses F_2 ratios of 15 : 1, indicating the presence of duplicate factors for certain characters in the New World cottons. There are also indications of several genes for lint length, boll shape, fuzziness and the number of chambers in the ovary, but generally the usual 3:1 ratios are obtained, indicating the presence of single factors. The frequency with which such multiple factors may be expected to present themselves will depend, however, upon the number of gene mutations which have occurred in the tetraploid strains since they first appeared, and this in

* That is, two or more genes for the same character.

turn will depend upon the length of time which has elapsed since they were produced as allotetraploids. The relatively scanty evidence of duplicate genes in the cottons would, therefore, favour their origin at a more remote period rather than within the last three centuries; but, on the other hand, if the parental species of the allotetraploids were distantly related they would already have a minimum of genes in common.

These and some of the other points already mentioned in regard to the genetics of cotton are matters on which it is possible to hold different views at the present time. As our knowledge advances they will gradually pass out of the realm of discussion into that of determined fact, but in the meantime discussion from different points of view is of value in clearing up the points at issue.

The best evidence that the Asiatic cottons were originally modified allotetraploids when the genus Gossypium originated is found in the observation by Davie of secondary pairing of the meiotic chromosomes* in *G. herbaceum* ($2n=26$). He found here in certain cases the maximum amount of secondary association—*i.e.*, six groups of two pairs (bivalents) each, and one single pair, clearly indicating that *G. herbaceum* is a modified tetraploid and that 13 is a secondary basic number, probably derived from an ancestral number 7.

The recent work with cotton and its relatives has thus opened up some very interesting problems and brought new evidence which will throw light upon the origin of the cottons and their genetic behaviour. The fact that several other genera of the Malvaceæ have 13 chromosomes as their basal number shows that parallel evolutionary processes have been taking place in other parts of the family. A general survey of their cytology and genetic behaviour is thus clearly indicated. A broad attack on the genetics of the Malvaceæ, especially as regards their cytology and phylogeny, may be expected to serve as the basis for a more knowledgeable and hence more successful advance into the genetics of Gossypium itself and the production of new and more valuable types of cotton. Recent experience has shown that a world survey of the forms available, and their relatives, is one of the most serviceable means to this end.

* That is, the pairs of chromosomes in the pollen mother cells.

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SOME WEST AFRICAN SOCIAL CUSTOMS

BY

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THE appropriateness of an article on West African social customs in a journal devoted mainly to the study of cotton-growing is not very obvious. Yet it is a matter of history that large numbers of the Ibo people of Nigeria together with people of other West Coast tribes provided the bulk of the slave labour in the West Indies, Brazil and the Southern States of America, which gave the New World an advantage in the production of cotton which it has never lost.

This exploitation of human beings was begun by the Portuguese in 1517 and was followed with greater energy by the Dutch from 1595. In the reign of Elizabeth Sir John Hawkins secured for England a large share of this profitable business, so that between 1680 and 1700 600,000 slaves were exported from West Africa by Englishmen; and between 1700 and 1786 slaves to the number of 610,000 were exported from West Africa to Jamaica alone. It was to Jamaica that a large number of the coast tribes of Nigeria were transported, as well as to the other islands of the West Indies.

Cotton and sugar cultivation was the main work allotted to slaves in the West Indies and the Brazils, until the more suitable conditions in the Southern States of America led to the concentration there of cotton-growing. It is an interesting fact that in the reign of Elizabeth Sir Fulk Greville reported that large quantities of cotton-wool were imported into Europe from the coast of Guinea.

In 1850 it was estimated that the cotton used for the manufacture of cloths—each one requiring about 4 lbs.—exported to the Brazils amounted to about 7½ million lbs.

Such are some of the relevant historical facts of the connection of the West Coast with the production of cotton. What bearing has the presentation of an account of social customs of an African tribe upon present-day problems of cotton cultivation? The answer is that the more knowledge acquired of the mentality and social customs of Africans in our Protectorates the greater the assistance this should be to trade in its various forms, whether it be the cultivation and export of cotton or other raw materials, or the export from Lancashire of manufactured cotton goods for African consumption.

The success or failure of this trade depends far more than is generally realized upon a sympathetic understanding of the needs of Africans and their likes and dislikes; and these needs are discoverable only by a patient study of the African himself and the social customs which regulate his life.

VISITING.—When a man of some standing visits another of equal position in a neighbouring town he puts on his cap, a red fez, if he is chief, and attires himself in his best dress, which may consist of a loose cloth tied round the waist and a light blanket thrown over his shoulders. He wears no boots or sandals, but his ankles are tied with the Owolo, strings of dyed red cotton thread which indicate his title. He wears copper or ivory bracelets on his arms, and carries a chief's iron spear, or Alo, and an ivory horn. A son or small servant boy goes in front of him carrying a chair or stool carved out of one piece of timber, or, instead of a stool, a skin of a goat or ram, and a small bell attached to the skin which rings perpetually when it is carried.

On approaching the compound of his friend he blows his horn to announce his arrival. He walks through the large door, covered with chip-carving, and into the guest chamber, where his fellow-chief receives him. The visitor salutes his friend by his special names of honour, and the two men extend their hands, each taking the fingers of the other between his middle finger and thumb, withdrawing them with a snap.

The host now calls for kola nut, which is brought on a wooden platter by a son or small boy, or occasionally by his wife. He may first of all wash his fingers in a bowl of water, or he may not. Then he takes several kola nuts from the pod, and with his long thumb-nail scrapes off the white skin covering, revealing the purple coloured nut and then, inserting his thumb-nail into the point of the nut, splits it according to its natural divisions and places them in the platter. He takes a piece himself, and the rest are handed to the guest and round to all present in order of seniority, each taking a little piece and chewing it. Women often receive kola nut bending upon one knee. A not uncommon practice before giving kola or a present of food is for the donor to touch it with his tongue and by so doing show that there is no poison in it.

Europeans find kola nut too bitter to enjoy, but it is eaten with great relish by all Ibo men. After the kola nut comes the offer of palm wine, which is brought into the guest-house in a clay pot or a calabash. A young man usually sits down on the ground, and with the pot on his extended knees pours with his right hand into a calabash cup or cow's horn, or (as is now quite common) into a glass tumbler, which is

never cleaned after use, and only rinsed if exceptionally dirty just before it is required. The palm wine is sipped first by the host to show that there is no poison in it, and then passed round in the one cup to all present until it is finished, the sediment being given to the young man as his special portion.

The visitor sometimes is given a stick of white kaolin, and with it he makes short vertical strokes on the ground according to his rank. If he has taken, say, the title Nfiekwu, he makes two strokes; if, in addition to this, he has taken the Ọzọ title, he makes five strokes, or if that of Oma-alo as well, eight strokes. The white marks on the floor are allowed to remain to testify to the fact that the householder has had a distinguished visitor.

Sometimes the host will say to the visitor "Enwerọm ọji,"—"I have no kola nut," which means that he has nothing in the way of palm wine or anything else, such as tobacco, which are counted as kola nut. He then produces a piece of white kaolin, which the visitor takes and crushes and rubs on one or both eyelids, and in curves round one or both eyes. Sometimes the big toe of the right or left foot is marked along its whole length with kaolin by the visitor. Such marking formerly was a protection, because it signified that he had friends in the town who would stand by him if he were molested in any way. A man who missed his way and found himself in a strange town had but a very small chance of leaving it again alive, but anyone connected by friendship or even remote relationship was treated with consideration as an honoured visitor. It is quite common to hear voices in the night of people returning from a visit shouting the praises of the people they had visited who had treated them liberally with palm wine.

In the western area a pipe of tobacco is offered to a visitor when he calls. The bowl is made of earthenware, about 2½ inches wide at the opening and 3 inches deep, with a stem made of a hollow reed or stick about 3 feet long. The host fills the pipe with tobacco leaf, either home grown or imported, picks out a live coal from the fire, and puts it in the bowl. Then he blows through the stem so as to ignite the tobacco, and takes one long pull, and holding the smoke in his mouth for a moment, he puffs it out, and passes the pipe on to his guest, and so on to all the men and women assembled, who follow his example.

Snuff is offered to friends met on the road, and kola nut also, and an old man is seldom without his snuff bottle.

Hospitality.—If a visitor happens to enter a house when a meal is in progress he is invited to share in the meal whatever the amount

of food, whether there is only just enough for those who are eating or an ample supply for all. If a feast is prepared for visitors, it is considered impolite for them to consume everything put before them. Sometimes three or four kinds of food are placed in succession before them, and after each course some would be left for the hangers-on and boys who are always at hand to clear up the dishes.

The Ibo people generally are very hospitable to those who come to visit them. For Europeans they will clear out a room, or a house, and place it at their disposal. It is true that the fowls, goats and occasionally a pig share the room assigned to the visitor, if they have been accustomed to use it for their night quarters. Sometimes a goat with a cold has sneezing fits, which makes sleep almost impossible. The floor is usually well rubbed with clay and comparatively clean, but the clothes of the visitor become impregnated with wood smoke because there are no chimneys. If his camp bed is put up under a roof in which maize has been stored in cobs with their sheaths left on, the rats have a way of nibbling at the cobs so that the liberated grains of maize drop continually throughout the night on to the floor. In addition to a room or house, wood for fuel, and water, will be provided, and also frequently yams, a goat and fowls sufficient for the visitor's meals, and those of his servants during the stay. No pay is asked for, and a present of tobacco is quite sufficient as recognition of the hospitality provided, and perhaps a share in the flesh of the goat, which is greatly appreciated. The writer has often been embarrassed by the number of presents received, and particularly by the large numbers of eggs, most of which were bad or addled. Coconuts also are cut fresh for a visitor, and the water of the nut forms a pleasant and safe drink in a land where water is not always fit to drink, even when it is boiled.

Salutations.—The salutations are many and they are essential to the maintenance of good relations. In the morning the salutation is: " Iputago n'ula ? " (Have you come out from sleep ?), and the answer " Aputagom " (I have come out), or " Ibọala chi," and the answer " Abọalam "—both having the same meaning as the former salutation and answer.

The salutation on the road or on meeting anyone is " Nnua " (singular), " Nnuanu " (plural), and the acknowledgment " O," which is never omitted.

When a man is at work on the farm or other occupation he is saluted " Dalu ọlu," or " De-eme " (I salute you for work), and to express sympathy with a sick man, Ndo, Kasie, or Ka-a-wo is used. To all these salutations the acknowledgment " O " in a high tone

and prolonged is made, otherwise it is considered discourteous. If the man is known, his title is mentioned with the salutation—*e.g.*, " Ogbu efi " (the cow-killer), " Otigbu-Anyinya " (the horse-killer).

The salutation at night is " Ka chi fo " (Until the day break), and to one going home, " Nọdu nma " (Sit down well), or " Nebi ọfuma " (Be living well); and to one going on a journey, " Nagbo " (Come home quickly), or " Nma-nma " (Good, good), a general salutation expressing good wishes. Another interesting salutation is " Anwula " (Do not die). If a man carrying a spear salutes another, he takes it in his left hand and shakes his fist, raised to the level of his head.

Kissing is unknown, but a mother will sometimes put her lips to the lips of her child, and this is called " Isusu ọnu " (The pressing of the mouth). A gramophone record on one occasion was put on which represented the sound of two persons kissing in the usual European manner and the native listeners, when asked what they thought it was, replied, " Some one calling goats."

If a man beckons to another he does so with his palm down, and his fingers extended but moving downwards, and bent towards himself, and never with his palm and finger upwards as in the European method.

Abruptness of manner is considered very impolite. If a man has a request it is never preferred in a direct manner, but introduced by matters which appear to be quite irrelevant, and the real request concealed until it is brought out by questions. It does not pay to cut a story short because it spoils the temper of the story-teller by depriving him of the real pleasure of the narration, and then it is difficult to get the information which is desired.

To startle another by appearing suddenly from hiding or to make a noise suddenly is generally considered to be very bad taste, probably because of possible evil effects. A woman will call out the name of her Chi, her tutelary spirit or guardian, or the name of her husband when startled, and a woman with child will turn her face away from a white man if she meets one suddenly.

Family Life.—A son follows his father to farm as soon as he is old enough to use a cutlass or a hoe, until the age of about fifteen, when he is considered old enough to farm on his own account. His father then supplies him with sufficient seed yam for a separate farm.

If the father dies when the son is a child, one of his relations will act as a father and look after the son as if he were his own child. A youth who has been supplied by his father or guardian with his needs for independent farming is not expected to depend upon him for supplies again, and if he fails to grow enough food for himself, he is

regarded as an "Ose-aka," literally "one who withdraws his hand" —*i.e.*, a worthless person. The result of such a system generally is to encourage diligence in farming and a commendable independence.

It is considered a blameworthy characteristic for a man to act secretly in anything, so as to hide it from his neighbours, or to pretend to be what he is not, and so get the reputation of being "Iru-abua" —*i.e.*, a person with two faces, or "Odikọdirọya," one who seems to be what he is not. Not only safety, but a man's reputation depends upon his openness in all his dealings. Anything secretive is suspected as indicating a plot against someone else, and is generally deprecated as a mark of bad character.

Hygiene.—An Ibo boy, who had been listening to a lesson on hygiene, asked how the principles set forth could be carried out when the fresh-water supply was several miles distant from the people, a not uncommon situation in some areas.

The question suggests the fact that the degree of cleanliness of the people varies with the distance from a good water supply. Where streams are available the people go every morning, and, after filling their water-pots, soap themselves all over and scrub themselves and each other with fibre, and where it is possible thoroughly enjoy a swim. Boys put pieces of soap on their hair before going to the stream for a wash, and spend a good deal of time in the water. Many towns depend for their water upon one stream, and the water is naturally most polluted for those who live farthest from the source by the washing of bodies, household utensils, and also by the nauseous washings of soaking cassava and bread-fruit in pools by the side of the stream. Most of the streams are swift—except when the rising waters of the main river force the waters of their tributaries back—and the pollution is quickly carried off. No one complains of the pollution, which is accepted as a necessary condition of existence, and the local deity whose name the stream bears is able to avert any evil results.

Men and women bathe together and remove their cloths apparently without any sense of indecency, though the bathing-places where conditions allow of it are sometimes separated. In many compounds both men and women have washing-places behind their huts, consisting of mat enclosures, which are made for this purpose.

Where water is scarce, people resort to rubbing their bodies with a preparation of camwood, which is supposed to be good for the skin, and even loin-cloths of cotton are sometimes rubbed with this paste. A common method of washing the body where water is precious is for a man to take a mouthful of water and then spray it over his body. This spraying by the mouth is often employed in building,

when the clay has to be damped before it is beaten smooth with mallets, or when tobacco leaves are to be made soft.

Fingers are usually rinsed before and after meals, though " washing-up " is postponed till the next occasion when the utensils are required.

The practice of rubbing floors with wet clay or green leaves, the juice of which dyes the floor a deep green, and also in some parts with cow dung, makes for cleanliness. The broom, " aziza "—a bundle of stiff fibres about a yard long tied at one end—is the simplest and most effective broom ever invented, and it is in constant use both indoors and out.

Where the water supply consists of surface drainage, it is sometimes prepared for drinking by the admixture of a special kind of earth which precipitates the heaviest matter. Some of those who have been brought up on surface water declare that they prefer it to that of a clear spring. Goitre is specially noticeable in the western area where these water-holes, called Ọmi, are so much used, but this may be only a coincidence.

Everywhere the people use a toothbrush, " atu." It is a stick 3 or 4 inches long and about the thickness of a lead pencil, cut from a shrub with aromatic or astringent properties. The " atu " is used when the sap is in the wood, and prepared for use by the end being chewed into a kind of brush. It is applied vigorously to the teeth, and then finds a resting-place over the ear of the user. Combs are used for the hair, and small bone spatulas employed for cleaning out the ears.

The custom of smearing oil or fat on the elaborate plaited coiffures of both men and women, and that of anointing the body with oil or camwood paste, and the decorating of the body with patterns in a black dye which is removable by washing, do not make for cleanliness, and skin diseases are very common. The loathsome disease of yaws is regarded as inevitable, and no precautions are taken to avoid spreading the infection.

The surroundings of houses, and particularly the " bush " on the outskirts of a town, are used for latrine purposes, and in the dry season the effect is decidedly malodorous. Vultures, dogs, and pigs perform the work of public scavengers. The general absence of clothing, however, is conducive to cleanliness, and native huts are on the whole clean, and may be occupied by European travellers without serious discomfort, save for the smell of wood smoke, which pervades everything.

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HARVESTING OF GROUNDNUTS

BY

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[The following note received from the Economic Botanist, Nagpur, dealing with a special implement in use at the Akola Farm for lifting groundnuts and at the same time ploughing the land, may prove of interest to cultivators in other cotton-growing countries of the Empire where groundnuts are grown in rotation with cotton. Fully dimensioned working drawings have been supplied, and if required can be sent on loan.—ED.]

I.—INTRODUCTORY.

THE importance of groundnuts as a rotation crop with cotton is now being increasingly recognized. Experiments conducted on the Government Experimental Farm, Akola, have conclusively shown that a three-course rotation consisting of cotton, juar and groundnuts gives the best financial return under the conditions obtaining in the cotton-growing areas of these provinces. The results of these experiments, as well as information relating to the improved strains of groundnuts which it has been possible to evolve, have been disseminated amongst the cultivators by means of leaflets printed in the vernacular, and it is safe to say that the tendency in the near future will be towards an increase in the acreage of groundnuts.

Unfortunately, there are factors seriously operating against the expansion of the area under this crop, the greatest of which perhaps is the high cost of cultivation. Compared with cotton and juar the cultivation of groundnuts entails a much heavier monetary expenditure, as will be seen from the figures of average cost of production given below for each of the three crops.

Name of Crop.	*Average Cost of Cultivation per Acre.*	
	Akola Farm.	*Cultivator.*
	Rs.	Rs.
Cotton	30	20
Juar	15	10
Groundnuts	50	30

Without doubt, at such high cost many cultivators in these times of financial stress find themselves unable to afford to grow groundnuts to any considerable extent. Expansion under such conditions is bound to be a very slow process, and the chief need of the moment is the finding of means whereby the cost of raising this important crop can be effectively reduced.

Furthermore, the harvesting of a good crop of groundnuts requires some 18-21 female coolies per acre, and the difficulty of obtaining the requisite labour for this purpose, should the Berar cultivator decide to adopt the three-course rotation recommended to him, must not be lost sight of. Also, it is not unusual for the lifting period of groundnuts to coincide with cotton-picking, and as the latter operation is relatively light, easy and remunerative, it may be difficult to obtain adequate labour at the right time for harvesting the groundnuts, and a considerable part of the crop may thus be lost or damaged.

II.—Reduction in Cost of Lifting.

To the solution of some of the problems enumerated above, the investigations carried out on the Government Experimental Farm, Akola, have made no small contribution. The method of lifting the groundnuts crop has been greatly improved, and it has been shown that by using a special plough the cost of harvesting can be reduced by over Rs. 5 per acre, while the operation is at the same time more speedily performed.

The common method of lifting groundnuts in Berar consists in *the uprooting of plants by hand and tying them together in bundles* of 12-20 plants which are left to dry either in the field or near the barn. The bundles are frequently turned until they become thoroughly dry, when pod-plucking is carried out. Not infrequently, the crop is uprooted before it is even fully mature and the pods plucked immediately after, with the object of increasing the weight of the produce. This practice, however, cannot be too strongly deprecated, as immature and green pods are liable to set up fermentation during storage, and the oil extracted from such stock has a rancid flavour.

The work of ploughing up the land from which the groundnuts crop has been removed is not undertaken till rather late in the season—*i.e.*, after cotton-picking and other operations connected with it have been completed. The cost of harvesting and ploughing by this method amounts to Rs. 13/12/- per acre, as will be seen from the following details:

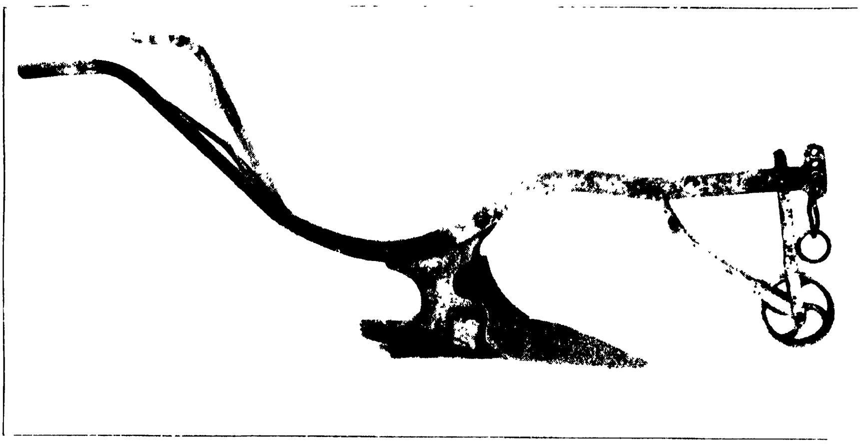

Fig. 1

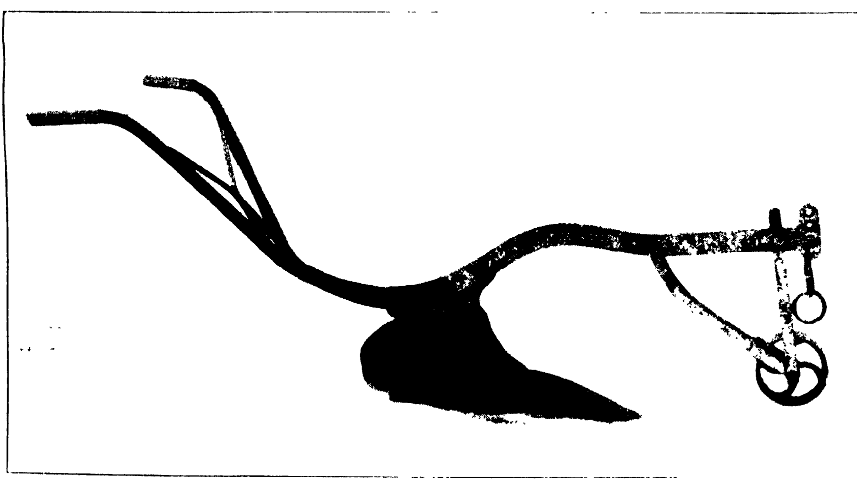

Fig. 2.

Description.	*Amount.* Rs.	As.	P.	*Amount.* Rs.	As.	P.
Harvesting :						
Wages of 21 female coolies required to harvest 1 acre				5	4	0
Ploughing :						
2 men at the plough at Rs. -/8/- per day	1	0	0			
2 pairs of bullocks at Rs. 1/8/- per day	3	0	0			
1 boy with the leading pair at Rs. -/4/- per day ...	0	4	0			
Total	4	4	0			
Work done per day, ½ acre.						
∴ Cost of ploughing 1 acre				8	8	0
Total cost of harvesting and ploughing 1 acre				13	12	0

The existing practice of harvesting this crop will thus be seen to be both expensive and laborious. A cheaper and speedier method is needed, and this is provided by simultaneously lifting the crop and ploughing the land by means of a special plough known as the "Combined Groundnut Lifter and Plough" now in use on the Akola Farm. This simple implement (Fig. 1) provides an efficient means for lifting groundnuts without loss of or damage to the pods, while the land is at the same time ploughed up six months ahead of the next season and derives the benefits of a cultivated fallow.

The design of the plough is based on the study of the morphological characters and habit of growth of the groundnut plant. The pods of groundnuts cluster around the plant about 2½-4 inches below the ground, and the plough is so constructed that it cuts an inch or two below the zone of pod-formation, gradually pushing up the soil in such a way that the pods lie disengaged from the soil and can be easily picked up and tied into sheaves by the female coolies following close behind the plough. With the mould-board fitted up (Fig. 2), it serves as a common inversion plough suitable for local soils from November to April. As a lifter, it requires two men, two pairs of bullocks, one boy for driving the leading pair, and eight female coolies for picking, tying and stacking the plants.

This method of lifting and ploughing has been successfully used on the Akola Farm during the past three seasons, and has resulted in a saving of about Rs. 5 per acre, as will be seen from the details given on page 212.

Briefly stated, then, the new method employs less labour, is more economical, and enables the land to be ploughed up earlier in the season before it becomes too hard and consolidated. Winter weeds are thus destroyed and the land can be prepared early for sowing cotton, even before the break of the monsoon if necessary. In

addition, the ploughing work for the bullocks in the spring and summer months is considerably reduced, which under the conditions of Berar is a very big advantage.

COST OF LIFTING AND PLOUGHING BY COMBINED LIFTER AND PLOUGH.

Description.				Amount.		
				Rs.	As.	P.
Labour :						
2 men at the plough at Rs. -/8/- per day				1	0	0
2 pairs of bullocks at Rs. 1/8/- per day				3	0	0
1 boy with the leading pair at Rs. -/4/- per day				0	4	0
8 coolies (female) (at Rs. -/4/- per day) for picking, tying and stacking				2	0	0
Total				6	4	0
Work done per day, 0·75 acre.						
∴ Cost of lifting and ploughing 1 acre				8		
Cost of lifting and ploughing 1 acre by old method	13	12	0			
	− 8	5	4			
Saving per acre compared with old method ...	= 5	6	8			

The construction of the special plough is quite simple. The essential parts are, of course, the share and the specially designed body-face or pseudo-breastplate. Groundnuts are sown in rows 12 inches apart, but the share is made to cut a 7-inch wide slice, as by this means each journey results in the complete lifting of one row and the ground is at the same time properly ploughed up. The mould-board-like expansion on the body-face is so designed that no breaking of pods takes place nor are any pods left under ground.

Received May, 1934.

COTTON STATISTICS

BY

JOHN A. TODD, M.A., B.L.

World's Crops.—The figures of the major crops for season 1933-34 are now pretty well known, and the position is briefly, that after all their efforts at reduction the American crop is just a trifle more than last year's, but Outside Growths show an increase of about 2 million bales, which makes it a new record total. This increase is very widely spread, Mexico, Brazil, Peru, Argentine, China, Russia and Egypt all showing figures larger than last year, which, it will be noted, was a very poor year in most of these cases. Several of them look like establishing new records this season, but as present estimates may not be confirmed it is hardly worth while detailing these at the moment. The Indian crop also shows a small improvement on last year's figure, but is still far below the record of 6,215,000 bales in 1925-26. The fact remains, however, that if linters are excluded, Outside Growths form a larger percentage of the total this year than they have ever done before (51 per cent.). The previous years when the percentage was nearly as high, 1921-23, were because of the failure of the American crop in these years owing to the boll weevil. This time it is due to the steady increase of Outside Growths.

American Crop.—The final figures for 1933-34 have made very little change from those already published in December and March, except that the figures of acreage harvested have been slightly reduced again, while the crop has been raised a trifle, so that the yield per acre which was reduced in December has now been raised again to 208·5 lbs.

Indian Crop by Varieties.—This table shows that the slight increase of the crop this year has been fairly evenly divided between the short and long stapled varieties, so that the crop percentages show hardly any change. The increase of *acreage*, however, was mainly in the short staple varieties, so that their average yield loses a little, while that of the longer staples gains rather more. Outstanding among the latter is the record average yield of 181 lbs. per acre for Punjab-American, and Cambodia is also very high at 180 lbs., though that is

not quite a record. Broach and Tinnevelly on the other hand show very low averages. But for these two the average yield of the long staple varieties as a whole would have been more like the high figures of 1921-1925, when they were running over 90 lbs. per acre.

Egyptian Crop.—The Egyptian Government's estimate in June has been revised to give effect to the changes in the details of the estimate which had been shown to be necessary by the ginning returns throughout the season. Roughly the result is that the actual out-turn of Sakel and Short staples is a little more than the December estimate, while other Long staples and Medium staples are substantially less. The total of 8,411,068 kantars, excluding Scarto, which will bring the figure just over 8½ million kantars, is a new record because the A.G.P.A.'s previous figure of 8,635,000 kantars for the Arrivals in 1926-27 included a considerable amount of cotton carried over up-country from the previous season. The details by varieties will be given in the October issue.

World's Consumption.—The Federation's figures for the first half of this season showed, on the whole, a very satisfactory result. The world's consumption of American was well maintained except in America itself and in Asia. In the U.S.A. the half-year's figures were better than the corresponding first half of the previous season, but not so good as those of the second half, which was only to be expected, because that included the record figures of the last three months. In Asia, on the other hand, the consumption of American has been steadily declining,* which, again, was only to be expected in view of the adjustment of the relative prices of American and Indian cotton to more like normal levels. But the outstanding feature of the returns for the first half-year is the marked increase in the consumption of Outside Growths, which applies to all varieties, Indian, Egyptian and Sundries, and to almost all the groups of countries. In the case of Egyptian the total of 544,000 bales for the half-year is a new record since half-yearly figures were published.

U.S. Consumption.—This table shows a continued recovery from the very low point of last December; this is best seen in the daily rate, which in March touched the highest figure for this season, except August, and in April was still well maintained. An interesting feature of the details is the comparatively heavy consumption of Egyptian in America this season. It may also be noted here that in recent years the U.S. consumption of Sea Island had fallen so low that it was dropped from the monthly returns, and only appeared in the season's

* *Cf.* April issue, p. 126. Garside has since reduced his estimate for the Orient very materially.

total, but last season the total suddenly rose again from 327 to 914 bales (of 500 lb.).

Futures Prices.—The sharp rise in New York prices in February due to the hope that the Bankhead Bill would restrict this year's crop to 9 million bales, gave place to a severe reaction when the Bill was watered down to a mere restriction of the amount to be *marketed* (except under a prohibitive penalty) to 10 million bales. The result is that the prospective reduction of acreage this season now depends on voluntary restriction only, under the Government agreements of last autumn, and the opinion is growing that this will barely succeed in keeping the acreage below last year's adjusted figure, and private estimates are running as high as 30 millions. On such an acreage the crop might be anything from 10 to 13 million bales, and on this uncertainty prices sagged heavily during April and May.

The danger of declining prices, however, is that it only leads to further demands for inflation. In March the President was bombarded with proposals for silver legislation, but his actual proposals in May disappointed the inflationists.

Liverpool prices followed the rise in New York with some reluctance, but Egyptian prices, especially Uppers, were much slower to rise, with the result that in May the Uppers percentage premium on American touched what is probably a new low record (for futures) at 9·0 per cent. Sakel, on the other hand, owing to the fact that it is practically the only part of the Egyptian crop to show any restriction this year, maintained its price much better, but its movements compared with Uppers have been extremely irregular.

Spot Prices.—Outside Growths conspicuously failed to follow the rise of American in February, but with the reaction they marked a slight relative improvement. Here, again, it will be noted that the spot price of Uppers touched a new low level in April at only 6·5 per cent. premium on American.

World's Carryover of Egyptian Cotton.—With a crop of at least 8½ million kantars and consumption running at the rate of about 8 millions it seemed clear that there must be an addition to the Carryover at the end of this season, but up to the end of January there was no sign of this, the Mid-Season figure being actually 100,000 kantars less than a year ago. Since February, however, the monthly totals have been falling very slowly, and the final result will probably depend on the amount of the Federation Mill Stocks outside of the U.S.A., which it will be noted touched a very high figure in January—1,672,000 kantars. There is, however, a previous record of 1,852,000 in January, 1920.

WORLD'S COTTON CROPS.

(Bales of 500 Lbs.—000's).

	1928–29.	1929–30.	1930–31.	1931–32.	1932–33.	1933–34.
U.S.A. Lint	14,478	14,825	13,932	17,096	13,002	13,047
Linters	1,282	1,241	986	1,067	912	950
Total	15,760	16,066	14,918	18,163	13,914	13,997
Mexico	272	240	174	206	96	223
Brazil	528	564	470	556	357	650
Peru	220	266	243	224	227	275
Argentine	129	138	150	165	152	200
Other South American	65	66	52	37	43	40
India*	5,782	5,243	5,224	4,007	4,656	4,970
China	2,394	2,055	2,317	1,705	2,211	2,637
Japan and Korea ...	147	137	153	99	129	148
East Indies, etc. ...	16	18	18	14	14	14
Russia	1,174	1,279	1,589	1,851	1,750	1,890
Persia	90	73	72	110	100	100
Iraq, Ceylon, etc. ...	4	4	3	1	†	†
Asia Minor and Europe	138	143	119	131	65	92
Egypt	1,602	1,697	1,589	1,313	1,010	1,785
Sudan	129	127	96	188	110	131
East Africa (British)	196	131	165	186	265	256
South Africa (British)	8	14	8	3	2	2
West Africa (British) ...	26	35	15	5	19	19
Non-British Africa ...	109	121	128	93	90	90
West Indies (British) ...	4	4	4	2	2	2
West Indies (Others) ...	23	25	21	30	26	25
Australia, etc.	5	12	10	4	10	16
World's Total ...	28,817	28,458	27,538	29,093	25,248	27,562
Outside Growths ...	13,057	12,392	12,620	10,930	11,334	13,565
Per cent. on Total ...	45·3	43·5	45·8	37·6	44·9	49·2

* Government Estimate, 400 lb. bales. † Less than 500 bales.

AMERICAN CROP (EXCLUDING LINTERS).

	1928–29.	1929–30.	1930–31.	1931–32.	1932–33.	1933–34.
Acreage planted (000's)	43,735	44,458	43,339	39,109	36,542	40,852
Acreage harvested ...	42,432	43,242	42,454	38,705	35,939	29,978
Crop (running bales)...	14,297	14,548	13,756	16,629	12,710	12,664
Yield per acre (lbs.) ...	163·3	164·1	157·0	211·5	173·3	208·5
Season's average spot price (Liverpool—pence per lb.) ...	10·52	9·09	5·71	4·82	5·62	

Progress of the Season 1933–34.

	*August.**	*Sept.**	*Oct.*	*Nov.*	*Dec.*	*March.*
Acreage planted ...	30,494	30,402	30,402	30,402	30,533	30,533
Acreage harvested ...	29,704	30,036	30,036	30,036	30,144	30,144
Crop (500 lb. bales) ...	12,314	12,414	12,885	13,100	13,177	13,043
Yield per acre (lbs.)...	194·8	197·8	205·3	208·7	209·4	206·8

* July acreage planted 40,798, less special abandonment.

INDIAN COTTON AREA, CROP, AND YIELD PER ACRE *BY VARIETIES.*

Varieties.	1932-33. *Area (Acres).*	1932-33. *Crop (Bales).*	1932-33. *Yield per Acre (Lbs.).*	1933–34. *Area (Acres).*	1933–34. *Crop (Bales).*	1933–34. *Yield per Acre (Lbs.).*
I. *Mainly under ⅞ Inch Staple :*						
Oomra (Khandeish, Central India, Berar, and Central Provinces) ..	6,666	1,244	75	7,034	1,173	67
Dhollera	2,747	712	104	2,380	560	94
Bengal Sind (United Provinces, Rajputana, Sind, Punjab, etc.) ..	2,807	774	110	3,915	1,152	118
Comilla, Burma, etc.	478	105	88	548	138	101
Coconada	189	26	55	168	25	60
Total under ⅞ inch staple	12,887	2,861	89	14,045	3,048	87
Per cent. of total crop	57·3	61·4	—	59·2	61·3	—
II. *Mainly ⅞ Inch Staple and Above :*						
Punjab (American)	776	217	112	805	364	181
Sind (American)	99	33	133	124	34	110
Broach	1,308	322	98	1,266	225	71
Coompta Dharwar	1,451	230	63	1,368	247	72
Western and Northern	1,568	189	48	1,724	200	46
Tinnevelly	541	135	100	528	124	94
Salem	191	35	73	198	38	77
Cambodia	322	139	173	352	158	180
Barsi and Nagar	2,450	364	59	2,353	379	64
Hyderabad Gaorani	890	131	59	976	153	63
Total ⅞ inch staple and above ..	9,596	1,795	75	9,694	1,922	79
Per cent. of total crop	42·7	38·6	—	40·8	38·7	—
Grand total	22,483	4,656	83	23,739	4,970	84

EGYPTIAN CROP.

	1928–29.	1929–30.	1930–31.	1931–32.	1932–33.	1933–34.
Area (feddans, 000's) ...	1,738	1,841	2,082	1,683	1,094	1,804 (Estimates)
Crop (kantars, 000's):						
Alexandria adjusted arrivals	8,012	8,485	7,947	6,563	5,050	8,925
Government figures*	8,068	8,531	8,276	6,357	4,956	8,581
Average yield (kantars per feddan)	4·64	4·63	3·97	3·78	4·53	4·76
Season's Average Spot Prices (Liverpool—Pence per Lb.).						
Sakel	18·14	14·52	9·06	6·80	7·79	
Percentage on American	72·4	59·7	33·6	41·1	38·6	
Uppers	12·12	10·47	6·86	5·68	7·01	
Percentage on American	15·2	15·2	20·1	17·8	24·7	

* Final revised figures, including Scarto.

WORLD'S CONSUMPTION OF COTTON.

(FROM THE STATISTICS OF THE INTERNATIONAL FEDERATION.)

(*Running Bales, 000's—Excluding Linters.*)

Variety.	*Season.*	*U.K.*	*Continent.*	*U.S.A.*	*Asia.*	*Others.*	*Totals.*
American.	1928–29	1,910	4,614	6,778	1,431	333	15,066
	1929–30	1,474	4,055	5,803	1,427	256	13,015
	1930–31	991	3,242	5,084	1,345	239	10,901
	1931–32	1,342	3,343	4,744	2,636	251	12,316
	1932–33	1,400	3,836	6,004	2,655	276	14,171
1st half	1933–34	771	2,083	2,847	1,148	173	7,022
Indian.	1928–29	183	1,150	35	3,766	44	5,178
	1929–30	188	1,375	61	4,403	60	6,087
	1930–31	252	1,215	43	4,318	35	5,863
	1931–32	183	727	21	3,834	23	4,788
	1932–33	126	600	16	3,455	23	4,220
1st half	1933–34	109	420	5	1,808	27	2,369
Egyptian.	1928–29	365	401	155	43	25	989
	1929–30	301	415	137	58	26	937
	1930–31	242	420	70	96	25	853
	1931–32	301	480	53	120	26	980
	1932–33	301	442	58	104	29	934
1st half	1933–34	189	242	37	57	19	544
Sundries.	1928–29	342	1,947	55	1,480	815	4,639
	1929–30	502	2,044	51	1,825	740	5,162
	1930–31	479	1,984	42	1,648	711	4,864
	1931–32	560	1.730	26	1,133	786	4,235
	1932–33	421	1,797	32	1,922	856	5,028
1st half	1933–34	203	903	18	1,017	458	2,599
All kinds.	1928–29	2,800	8,112	7,023	6,720	1,217	25,872
	1929–30	2,465	7,889	6.052	7.713	1,082	25,201
	1930–31	1,964	6,861	5,239	7,407	1,010	22.481
	1931–32	2,386	6,280	4,844	7,723	1,086	22,319
	1932–33	2,248	6,675	6,110	8,136	1,184	24,353
1st half	1933–34	1,272	3,648	2,907	4,030	677	12,534

U.S. CONSUMPTION OF COTTON BY VARIETIES.

(RUNNING BALES 000's: "FOREIGN" IN EQUIVALENT 500-LB. BALES.)

1932–33.	*Total.*	*Daily Rate.*	*Upland.*	*American Egyptian.*	*Egyptian.*	*Other Foreign.*	*Linters not Included.*
February ...	441·7	20·3	432·2	1·9	6·3	2·1	46·5
March ...	494·2	19·8	482·6	2·0	7·2	3·2	50·1
April ...	470·7	21·2	460·0	1·2	6·2	3·3	54·7
May ...	620·9	25·1	606·5	1·1	9·3	4·0	76·1
June ...	696·5	29·0	681·0	1·6	9·0	4·9	81·5
July ...	600·1	26·7	583·9	1·5	9·7	5·1	90·5
1933–34.							
August ...	588·6	25·6	571·3	1·2	11·3	4·8	83·3
September ...	499·5	24·1	485·7	0·9	9·2	3·8	76·5
October ...	503·9	23·2	489·0	1·1	9·6	4·2	66·8
November ...	475·4	22·1	461·8	0·9	9·0	3·6	59·1
December ...	348·4	19·4	338·9	1·1	6·2	2·2	51·6
January ...	508·0	22·3	493·8	1·1	10·2	2·9	57·8
February ...	477·9	24·2	463·8	1·5	9·3	3·3	59·7
March ...	543·7	24·7	527·9	1·3	10·7	3·8	74·5
April ...	512·7	24·4	499·1	1·1	8·6	4·0	67·8

HIGHEST AND LOWEST FUTURES PRICES.

1932–33.	*American.*				*Egyptian (Liverpool).*			
	New York.		*Liverpool.*		*Sakel.*		*Uppers.*	
	High.	*Low.*	*High.*	*Low.*	*High.*	*Low.*	*High.*	*Low.*
November	6·66	5·67	5·41	5·04	7·85	6·98	7·08	6·58
December	6·20	*5·53*	5·12	4·75	7·13	6·54	6·64	6·05
January ...	6·43	5·92	5·14	4·76	7·39	6·77	6·76	6·30
February	6·30	5·85	4·89	4·61	7·08	6·67	6·38	6·01
March ...	6·97	5·93	5·17	4·50	7·16	*6·45*	6·39	*5·80*
April ...	7·90	6·41	5·31	4·82	7·28	6·84	6·53	6·02
May ...	9·42	8·03	6·19	5·37	8·28	7·24	7·34	6·55
June ...	10·75	9·10	6·39	5·81	8·37	7·95	7·37	6·97
July ...	*12·00*	9·58	6·34	5·75	8·31	7·86	7·44	6·95
1933–34.								
August ...	10·66	*8·47*	6·12	5·22	8·02	7·00	7·21	6·33
September	10·71	8·94	5·58	5·15	7·34	6·84	6·46	6·01
October ...	10·08	8·83	5·47	5·15	7·21	6·79	6·26	5·91
November	10·30	9·41	5·29	*4·78*	7·08	*6·52*	5·99	*5·44*
December	10·29	9·96	5·20	4·96	7·55	6·78	5·99	5·67
January ...	11·49	10·30	5·93	5·19	8·42	7·57	6·58	5·99
February	*12·54*	11·53	*6·48*	5·92	*9·25*	8·36	*7·23*	6·61
March ...	12·38	11·71	6·40	6·04	8·91	8·35	6·99	6·69
April ...	12·23	10·86	6·14	5·62	8·62	7·90	6·80	6·18
May ...	11·59	10·70	6·05	5·57	8·37	7·88	6·63	6·14

Maximum and minimum figures in each season are given in italics.

LIVERPOOL SPOT PRICES OF AMERICAN WITH OTHER VARIETIES AS PERCENTAGES (Last Friday of Each Month).

1932–33.	*American (Middling). Pence per Lb.*	*Indian No. 1 Fine Oomra.*	*West African (Middling).*	*Brazil Pernam (Fair).*	*East African (Good Fair).*	*Tanguis (Good).*	*Uppers (F.G.F.).*	*Sakel (F.G.F.).*
November	5·44	89·7	100·0	101·8	120·2	125·7	129·2	139·0
December	5·29	89·4	100·0	101·9	119·8	125·5	131·4	137·4
January ...	5·15	89·5	100·0	101·9	117·5	125·2	128·9	139·4
February	4·95	89·5	101·0	103·0	119·2	126·3	129·5	141·8
March ...	5·15	80·0	100·0	101·9	117·5	126·2	124·3	137·9
April ...	5·53	80·7	100·0	101·8	119·9	124·4	121·2	134·7
May ...	6·07	80·1	100·0	101·6	114·8	122·2	120·4	134·6
June ...	6·38	80·6	100·0	101·6	114·1	121·2	116·9	131·2
July ...	6·47	81·0	101·5	101·5	113·9	120·9	118·7	131·1
Season's average	*5·62*	*86·1*	*100·7*	*102·0*	*117·4*	*124·2*	*124·7*	*138·6*
1933–34.								
August ...	5·53	79·6	101·3	103·1	115·7	124·8	122·4	136·0
September	5·60	80·7	100·9	103·6	114·3	124·1	114·6	132·0
October ...	5·54	78·3	100·0	102·7	113·5	122·6	111·0	127·4
November	5·09	77·6	100·0	102·9	114·7	120·6	112·6	137·7
December	5·33	75·6	100·0	100·9	114·1	124·4	113·5	145·2
January ...	6·07	74·0	99·2	99·2	111·5	120·6	109·9	140·4
February	6·67	73·2	98·5	97·8	107·5	118·0	107·9	136·6
March ...	6·35	70·1	98·4	94·5	107·9	118·9	108·0	137·6
April ...	5·88	70·9	100·0	94·9	109·4	121·3	106·5	137·2
May ...	6·20	75·2	99·2	95·2	108·9	120·2	107·6	135·8

WORLD'S CARRYOVER OF *EGYPTIAN* COTTON
(KANTARS 000'S).

End of	*Stock and Afloat.*		*U.S.A.*		*Alex-andria.*	*Monthly Totals.*	*Federation. Other Mill Stocks.*	*Half-Yearly Totals.**
	U.K.	*Conti-nent.*	*Mills.*	*Ware-houses.*				
1929, July ...	510	150	449	197	1,677	2,983	1,260	4,243
1930, January	*585*	*270*	*353*	*202*	*3,403*	*4,813*	*1,335*	*6,148*
July ...	353	135	483	245	3,616	4,834	1,297	6,131
1931, January	*630*	*293*	*341*	*129*	*5,349*	*6,742*	*1,185*	*7,927*
July ...	600	165	212	108	4,456	5,541	1,418	6,959
1932, January	*1,013*	*248*	*145*	*63*	*5,521*	*6,990*	*1,447*	*8,437*
July ...	885	203	161	180	3,780	5,209	1,553	6,762
1933, January	*878*	*218*	*134*	*169*	*4,255*	*5,654*	*1,425*	*7,079*
July ...	742	202	131	143	2,375	3,593	1,635	5,228
August	705	158	122	130	1,723	2,838	—	—
September	675	180	107	110	1,805	2,877	—	—
October	803	202	121	88	2,561	3,775	—	—
November	1,102	277	129	97	3,095	4,700	—	—
December	1,335	307	128	107	3,345	5,222	—	—
January	*1,507*	*337*	*143*	*106*	*3,207*	*5,300*	*1,672*	*6,972*
February	1,455	232	143	111	3,116	5,057	—	—
March	1,373	293	155	127	3,035	4,983	—	—
April ...	1,425	270	166	138	2,790	4,789	—	—
May ...	1,335	203	—	—	2,488	—	—	—

* Figures in *italics* to distinguish between Mid-Season and end of Season.

The following is the complete list of tables with the issues in which each appears:

	January.	*April.*	*July.*	*October.*
World's Crops	×	—	×	—
American crop	×	—	×	×
Indian crop	—	×	—	×
Indian crop by varieties	—	—	×	—
Egyptian crop	×	—	×	—
Egyptian crop by varieties	—	—	—	×
Sudan crop	—	×	—	—
World's consumption (Federation) ...	×	—	×	—
World's consumption (Garside)	—	×	—	×
U.S. consumption	×	×	×	×
World's Carryover, American	—	×	—	×
World's Carryover, Egyptian	×	—	×	—
Futures prices, American and Egyptian ...	×	×	×	×
Spot prices, other varieties	×	×	×	×
Prices, season's average	—	—	—	×

EMPIRE COTTON CROPS FOR THE YEARS 1923–33, EXCLUDING INDIA.

(In bales of 400 lbs.)

The seasons are given as covering two years (*e.g.*, 1926–1927) because in the majority of the countries named planting takes place in one calendar year and picking in the next. In a few of these countries, however (*e.g.*, Tanganyika, Iraq, Cyprus, Malta and some of the West Indian Islands), the crop is harvested in the same year as that in which it is planted. In such cases the figures should be read as relating to the crop grown and harvested in the *latter* of the two years at the head of the column.

COUNTRY.	1922–23.	1923–24.	1924–25.	1925–26.	1926–27.	1927–28.	1928–29.	1929–30.	1930–31.	1931–32.	1932–33.	
(1) Anglo-Egyptian Sudan ..	28,306	47,652	44,912	121,131	148,118	126,115	161,536	157,769	120,310	234,964	137,384	(1)
(2) Uganda ..	88,046	128,604	196,038	180,859	131,728	138,486	204,057	129,969	191,305	203,265	294,828	(2)
(3) Kenya ..	1,200	1,653	2,250	2,046	1,232	1,241	1,984	1,518	800	1,735	3,037	(3)
(4) Tanganyika ..	11,434	18,793	21,724	24,280	15,966	32,954	27,785	23,135	11,351	18,039	28,490	(4)
(5) Nyasaland ..	4,036	6,873	7,718	4,976	2,792	4,470	6,095	9,331	4,205	5,067	5,942	(5)
(6) N. Rhodesia ..	102	500	379	506	32	17	—	—	—	—	—	(6)
(7) S. Rhodesia ..	—	1,650	4,907	6,803	639	90	280	1,481	1,974	579	355	(7)
(8) Union of South Africa and Swaziland	6,523	8,730	16,936	20,381	10,242	11,013	9,774	16,213	8,123	2,801	1,860	(8)
(9) Nigeria ..	16,811	25,694	39,137	47,909	27,464	20,930	32,126	43,925	18,850	6,268	24,366	(9)
(10) Gold Coast ..	15	93	1,132	1,218	285	264	296	200	297	263	68	(10)
(11) Cyprus ..	2,233	3,397	3,320	4,614	2,110	2,146	3,520	4,718	2,865	1,119	913	(11)
(12) Malta .	118	573	782	507	342	541	379	293	201	41	34	(12)
(13) Iraq ..	1,100	2,400	2,540	3,500	1,800	5,200	4,700	3,300	960	409	—	(13)
(14) Ceylon ..	49	324	121	261	186	202	380	248	95	52	—	(14)
(15) Queensland ..	9,344	11,850	14,318	7,179	5,880	10,266	6,296	13,999	12,228	4,975	13,903	(15)
(16) Fiji	85	157	123	824	356	114	271	398	266	90	8	(16)
(17) West Indies ..	5,295	4,309	4,186	5,941	6,076	4,088	5,312	5,672	5,106	2,524	2,614	(17)
	174,697	263,252	390,523	432,935	355,248	358,137	464,791	412,169	378,936	482,191	513,802	
		Percentage Increase 50·6.	*Percentage Increase* 36·9.	*Percentage Increase* 20·0.	*Percentage Decrease* 17·9.	*Percentage Increase* 0·8.	*Percentage Increase* 29·7.	*Percentage Decrease* 11·3.	*Percentage Decrease* 8·0.	*Percentage Increase* 27·2.	*Percentage Increase* 6·5.	

NOTES ON CURRENT LITERATURE

COTTON IN INDIA.

322. The following reports have recently been received:

IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH. Ann. Rpt. for 1932-33.
AGRA AND OUDH: Rpt. on Admin. of Dpt. of Agr., 1933.
PUNJAB: Rpt. of Operations of Dpt. of Agr., 1933.

323. REPORT OF THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, 1932-33. An account is given of the work of the year in connection with the research schemes, animal husbandry, sugar, hemp, oil seeds, and locust control. At the request of the Indian Central Cotton Committee the Research Council have undertaken an investigation into the cost of production of cotton and of its principal rotation crops in the different Provinces and States. The Governing Body have approved the appointment of an economist, and the enquiry—spread over a period of three and a half years—will be conducted in 23 districts and 144 villages in seven Provinces: Madras, Bombay, Bengal, United Provinces, Punjab, Central Provinces, Bihar and Orissa; and in three States: Hyderabad, Mysore, and Baroda. The cost, estimated at Rs. 5,12,000, will be borne in equal shares by the Indian Central Cotton Committee and the Imperial Council of Agricultural Research.

324. INDIAN CENTRAL COTTON COMMITTEE. At the 28th meeting held on January 29, the President, Sir T. Vijayaraghavacharya, extended a cordial welcome to two distinguished visitors present on the occasion, His Excellency Lord Brabourne, Governor of Bombay, and Sir Richard Jackson, Chairman of the Indian Cotton Enquiry Committee, Lancashire. The important rôle played by cotton in the relations between India and the United Kingdom in the past, and its prominent place in the future relations of the two nations, were emphasized by the Vice-President, Sir Purshotamdas Thakurdas. Among many important matters discussed at the meeting were the following: The report of the Cotton Forecast Improvement Sub-Committee; the necessity for the reduction of railway freights; the unification of weights for kapas. The various research schemes financed by the Committee were reviewed, four schemes being extended for further periods, and four new schemes sanctioned. The progress report of the Director of the Technological Laboratory at Matunga showed that 185 samples were spun into 535 counts, 45 spinning test reports and 20 fibre and yarn test reports were issued during the period under review. It was agreed that the new stapling apparatus should be patented in all countries, and arrangements made for its manufacture and sale.

325. INDIAN CENTRAL COTTON COMMITTEE. We have received a useful illustrated pamphlet giving a good sketch of the objects for which the Committee was formed, and the way in which it is setting about their attainment. It also includes an account of the work of the Technological Research Laboratory, Bombay, the Institute of Plant Industry, Indore, the researches for improvement of cotton in the Punjab, the Punjab pink bollworm scheme, the white fly work, the Sind Physiological Scheme, etc.

326. INDIAN CENTRAL COTTON COMMITTEE. We have received from the Publicity Officer the following notices:

The Harmful Effects of Cholam on Succeeding Cotton Crop. The results obtained to date by the Madras Fodder Cholam Scheme financed by the Committee indicate that: (*a*) Deficiency of soil moisture was not responsible for fall

in yield; (*b*) the yield of succeeding cotton was reduced when cholam was allowed to run to seed; (*c*) there was no fall in the yield of cotton when cholam was cut at the shot-blade stage.

Fumigation Charges for American Cotton at Bombay. States the reduced fees payable from April 1, 1934.

327. Indian Cotton: Review of 1932-33 Season. We have received from Messrs. Chunilal, Mehta and Co., Bombay, a copy of their *Indian Cotton Review* for the 1932-33 season. It is stated that "exports of Indian cotton to foreign countries amounted to 2,800,000 bales, as compared with 1.600,000 bales in 1931-32. According to the International Cotton Federation, the consumption of Indian cotton by mills outside India amounted to approximately 1,900,000 bales, as compared with 2,492,000 bales in the previous season. The mill stocks of raw cotton outside India on July 31, 1933, were 617,000 bales, as compared with 341,000 bales in 1932 and 710,000 bales in 1931. Although, when compared with last year at the end of July the present stock of Indian cotton in the outside world appears to be larger, it is by no means above normal. . . . Owing to the high parity price for Indian cotton during 1931-32, which was brought about by the failure of the Oomra crop, the running stocks with foreign spinners were much below normal. Now only a normal size has been attained, and this does not mean excessive supply."

328. Estimated Production and Distribution of the Various Types of Indian Cotton. (*Stat. Bull. No.* 3, Ind. Cent. Cott. Comm., 1934.) A useful set of tables showing (*a*) The Indian cotton crop classified according to length of staple; (*b*) receipts at mills in India of raw cotton classified by varieties; (*c*) exports by sea of Indian cotton classified by varieties; (*d*) stocks of Indian raw cotton held in India by the mills and the trade on August 31, 1933; (*e*) stocks of raw cotton held by the mills in India on August 31, 1933; (*f*) Indian raw cotton consumed in Indian mills.

329. Some Notes on Indian Cotton. By Dr. A. J. Turner. (*Commercial Oldham,* viii., **2**, 1934, p. 7.) Indian cotton, hitherto regarded as short and dirty, has been much improved in the last twenty-five years as regards these attributes, and the possibilities of this cotton being used to a much increased extent in Lancashire are being thoroughly explored. A short description is given of the principal types. The average Indian consumption is about 2,700,000 bales, Japanese 1,800,000, European 1,000,000 (of which Great Britain takes about 200,000 bales). One reason for non-use by Lancashire spinners in the past has been the small stocks usually held in this country. This, however, is now being altered, and during the present season the stocks held in Liverpool and Manchester have been from two to three times as great as in either of the last two seasons, and there is little doubt that a continuation and expansion of this policy in the future will lead to an increasing popularity of Indian cotton with the coarse-count spinners in this country.

330. The Spinning of Indian Cotton. (*Text. Weekly*, xii., **310**, 1934, p. 638.) Practical hints are given on blowing-room adjustments, cleaning problems, carding, drawing frame settings, and staff changes necessary in the adaptation of mills originally laid out to spin medium American counts, to the spinning of Indian cotton.

331. Spinning Test Reports on Indian Cottons. By N. Ahmad. (*Ind. Cent. Cott. Comm. Tech. Circs.*, Nos. 112-3; 116-9; 121-2. 1933-34.) The circulars contain the grader's report and spinning-test results for Khandesh, Bengals, Ujjain, C.P. No. 1, Berar, Moglai, Muttia, Latur and Nanded cottons for the 1933-34 season.

332. INDIAN COTTON INDUSTRY: TARIFF HISTORY. By S. Sen. (*Wirtschaftsdienst*, **19**, 1934, p. 21. Abstr. from *Summ. of Curr. Lit.*, xiv., **5**, 1934, p. 135.) The history of tariffs in India is outlined, especially in relation to recent Japanese competition. Statistics are tabulated.

333. TECHNOLOGICAL REPORTS ON STANDARD INDIAN COTTONS. By N. Ahmad. (*Tech. Circs.*, Nos. 110-1; 114-5; 120. 1933-34.) Copies have been received from the Indian Central Cotton Committee of reports on the cottons named below. The particulars include agricultural details, grader's report, fibre particulars, spinning tests, remarks and conclusions.

1. *Umri Bani.* Area under cultivation 171,522 acres under Government seed, 754,042 acres under cultivators' seed. The 1933-34 cotton possesses better fibre properties than its immediate predecessor, and has given a slightly higher spinning performance. It is suitable for 29's warp.

2. *Verum* 262 (*Akola*).—Area under cultivation 89,560 acres. The 1933-34 sample was suitable for 21's warp, as compared with 25's warp in 1932-33.

3. *Punjab-American* 289 *F.*—Area under cultivation in 1932-33, 20,000 acres. Except for the neppiness of its yarns, this cotton has generally given very good results. It is suitable for 46's warp.

4. *Verum* 262 (*Nagpur*).—With the exception of the 1929-30 and 1932-33 seasons the performance of this cotton has been fairly constant. It is suitable for 24's warp.

5. *Punjab-American* 4 *F.*—The Lyallpur samples of 1932-33 and 1933-34 of this cotton are much superior to those of 1931-32, and have given stronger yarns than even the Khanewal samples. It is suitable for 25's warp.

334. INDIAN COTTON BALES: WATERING. By V. Motilal. (*Ind. Text. J.*, **44**, 1933, p. 98. Abstr. from *Summ. of Curr. Lit.*, xiv., **6**, 1934, p. 138.) The author protests against the growing practice of artificially damping bales of cotton with a hose-pipe in order to increase the weight by 2 or 3 per cent. He states that hessian wrappers last only one year instead of four or five when the bales are watered.

335. A NOTE ON THE WAX CONTENT OF INDIAN COTTONS WITH SPECIAL REFERENCE TO THEIR FEEL. By N. Ahmad and D. L. Sen. (*Tech. Bull.*, *Ser. B.*, *No.* 18, Ind. Cent. Cott. Comm., 1933.) *Summary:* The wax occurring on cotton fibre, though present in extremely small quantities, plays an important part in the spinning, wetting, dyeing, and scouring processes. It has, besides, a direct bearing on its feel as estimated by a grader. The wax content of eleven Indian and one non-Indian cottons has been determined principally with a view to correlating it with its degree of silkiness or harshness. The results obtained show that the wax content of Indian cottons may range from 0·229 to 0·468 per cent., that the exotic varieties grown in India have, on the whole, a higher wax content than the indigenous types, and that the *subjective* estimates of the feel of a cotton made by different graders are likely to disagree among themselves, and with the results of the wax determination tests. Comparing the reports of the graders with the results of the tests a tentative scale is suggested, in which the degree of silkiness of a cotton is expressed in terms of its wax content.

336. THE INDIAN TEXTILE INDUSTRY. (*Text. Rec.*, li., **6**, 1934, p. 60.) The comprehensive Bill for the protection of the textile industry of India was introduced in the Indian Legislative Assembly by Sir Joseph Bhore, the Commerce Member of the Government of India, who explained the objects of the Bill, and stated that consumers would not suffer by further extending the period of protection. He added that, to safeguard the handloom industry, they would spend an amount of Rs. 3½ lakhs annually to promote co-operative buying and selling, and that the Provincial Governments have been invited to propose a suitable scheme for the purpose.

337. Agra and Oudh: *Cotton Cultivation.* (*Rpt. on Admin. of Dpt. of Agr.*, 1933, recently received.) The policy of the Department has been to concentrate on the development of C. 520 cotton in the Western districts and on C. 402 along the new Sarda Canal area, partly because in the latter area canal water in the end of May is more reliable, and also, there is not so much very short-stapled A. 19 to contend with. C. 520 cotton, which is much superior to A. 19, is very popular, and efforts are being made to secure sufficient seed farms to multiply the cotton and also to ensure purity at ginning. In regard to C. 402, conditions were not favourable in the summer of 1932. The Sarda Canals ran very short up to the end of May, and when water was plentiful the first claim on its use was sugar-cane. As a result there was a distinct drop in the area planted to cotton, which did not exceed 1,400 acres, but a good yield was obtained.

338. The Sanitary Disposal and Agricultural Utilization of Habitation Wastes by the Indore Process. By F. K. Jackson and Y. D. Wad. (*Bull. No.* 1, Inst. of Plant Industry, Indore, 1934. Reprinted, with additions, from *The Ind. Med. Gazette*, lxix., 2, 1934.) The proper utilization of human and other refuse, partly no doubt on account of prejudice, has as yet made little progress outside of China, though it is admitted that plants grown with organic manures have a higher crop value and a greater vitamin content. In this paper the present efficiency of disposal and utilization of habitation wastes, affecting a considerable portion of humanity, is discussed. Its importance to agriculture is emphasized, and recent attempts to solve the problem are reviewed. The essentials of an improved system for general adoption are given, the futility of attempts at full nitrogen conservation in practice being stressed. The main features, advantages and mode of operation of the Indore process are indicated, and the quantitative relations of wastes and compost, its cost and agricultural value, and the scope for the application of the process are discussed. It is stated that by adopting the Indore system the financial loss, at present inseparable from the disposal of sewage, etc., can be converted into a profit, even though the resulting compost be sold at a very cheap rate. Details and illustrations of the working of the system are given in the appendix, and notes are included from the Inspector-General of Hospitals and Jails, Holkar State, and the Chief Medical Officer, Central India, discussing the advantages of the process.

339. Punjab: *Cotton Cultivation*, 1933. (*Rpt. of Operations of Dpt. of Agr.*, 1933.) The total area under cotton in British districts of the Punjab during the year was 1,889,938 acres, of which 776,263 acres were under American and 1,113,675 acres under Desi cottons. The total acreage shows a decrease of some 12 per cent. on that of the previous year owing to deficiency of rain at sowing time and the low prices ruling.

The cotton research work financed by the Indian Central Cotton Committee was continued. It included selection work, varietal tests, breeding of jassid-resistant strains, manurial, irrigation, and sowing date experiments. The investigations of white fly and pink bollworm were also continued with the help of the Committee. In addition, the Committee provided funds for the erection of a small ginnery at Lyallpur to gin the pure seed produced at that station and at Risalewala, and also financed scholarships in connection with (*a*) research on cotton jassids; (*b*) cotton marketing and economics; (*c*) ginning and pressing costs in the Punjab.

340. Report on an Enquiry into the Local Consumption of Kapas in the Lyallpur District in 1930-31. By S. P. S. Bhullar and S. A. Singh. (*Agr. and Livestock in India*, iii., 6, 1933, p. 564.) Of the total production of American

cotton, about 1 per cent. was locally consumed, and of Desi cotton about 14 per cent., in the sixty-three villages investigated.

341. Report of an Enquiry into the Sources of Seed Supply of Cotton in the Lyallpur District for the Years 1930-31 and 1931-32. By S. P. S. Bhullar and S. A. Singh. (*Agr. and Livestock in India*, iii., **6**, 1933, p. 579.) The Agricultural Department opened seed depots in all important rural areas to enable cultivators to obtain improved cotton seed, and the present enquiry was undertaken to find out how far cultivators availed themselves of these facilities. It was found that 90 per cent. of the area under Desi cotton was sown with home-grown seed, and 50 to 60 per cent. of the area under American cotton with purchased seed. More seed from the depots of the Agricultural Department was used by Sikh cultivators than by Mohammedan cultivators. It is considered that if additional seed depots are opened in suitable places, and the seed sold at cheaper rates, a much larger area will probably be sown with departmental seed.

COTTON IN THE EMPIRE (EXCLUDING INDIA).

342. The following reports have recently been received:

British Guiana: Div. Repts. of Dpt. of Agr., 1932.
Fiji: Agr. Jour., 1933, Pt. II.
Gold Coast: Rpt. of Dpt. of Agr., 1932-33.
Nigeria: Tenth Ann. Bull., 1931.
West Indies, *Grenada*: Rpt. on Agr. Dpt., 1932.

343. British Cotton Growing Association. The 29th Annual Report contains the usual interesting information. The year under review was fraught with difficulties, and except for a short period towards the end of the year, Lancashire enjoyed no measure of recovery, despite strenuous efforts made by many influences in the trade to bring about some improvement. An encouraging sign is the increased spirit of co-operation between the various sections, that has resulted in the formulation of schemes to raise prices to a level not below the cost of production. The total number of bales dealt with by the Association was 110,570, of a value of £1,595,630. The value of materials supplied to planters, ginners, and others concerned with the cultivation and ginning of cotton amounted to £30,324, as compared with £26,660 in 1932. The work of the Association in the Colonies is described, and useful statistical appendices are included. The report is well furnished with illustrations.

344. L'Angleterre et les Recherches Scientifiques sur le Coton. By — du Halgouet. (*Coton et Cult. Cotonn.*, viii., **2**, 1933, p. 99.) An interesting article discussing the work of the Empire Marketing Board, the British Cotton Growing Association, the British Cotton Industry Research Association, and the Empire Cotton Growing Corporation. The work of the last is described in detail, beginning with the political organization, the budget, the objects of the work, the methods employed, the results already achieved, and what it is hoped to achieve. A list of the Corporation's publications is included, and finally a short account is given of the work that is being done in India by the Indian Central Cotton Committee.

345. AFRICA. Roads *v.* Railways in Colonial Development. By J. W. Spiller. (*Crown Colonist*, iv., **29**, 1934, p. 157.) In the section of this paper dealing with the costs of motor transport, the author writes as follows: "The Nigerian Railway Department operates a fleet of vehicles providing feeder services to the railway, and in the year ended March 31, 1933, the vehicles ran

244,434 miles and carried 3,275 passengers and 11,935 tons of goods. The net loaded or goods ton-miles run were 537,000 at an average cost of 6·18d. per ton-mile, exclusive of interest and renewal charges.

"The Kenya and Uganda Railway also operates motor services in the neighbourhood of the Great Lakes, which in 1932 carried 11,204 passengers and 10,074 tons of goods. The average load per lorry-mile was 1·88 tons, and the total ton-miles run were 616,057, at an average cost of 6d. per ton-mile, including depreciation.

"The Uganda Public Works Department operates a fleet of cars and lorries for transport purposes, and in 1931 the lorry mileage run was 718,508 miles. The total all-in cost, including depreciation, insurance, etc., amounted to 10¼d. per lorry-mile. Road motor services are also operated by responsible firms in Uganda at rates approximating to 1s. per ton-mile, but in a number of cases irresponsible competition is carried on at rates as low as from 7d. to 9d. per ton-mile.

"In Tanganyika well-established transport companies run regular services of lorries for the transport of passengers, mails, produce, etc., over long distances in districts not provided with railways, at charges which vary from 1s. to 2s. per ton-mile. A difference is made in the rates charged according to the season, the rate being less in the dry season, while the highest rates are for the most remote districts. Where competitive with the railway, motor lorry rates vary from 8d. to 1s. 4d. per ton-mile.

"Thus the average operating cost is at least 6d. per ton-mile, and in Central Africa, in districts not provided with railways, transport charges vary from 1s. to 2s. per ton-mile. Where, however, the services are competitive with a railway, the rates are materially lower. By means of excessive overloading native-owned lorries can operate at less than 6d. per ton-mile, while low rates are often quoted in cases where vehicles would otherwise return empty. It is, however, doubtful if road transport can be operated permanently on economic lines over earth roads at less than 6d. per ton-mile."

346. GOLD COAST: *Cotton Cultivation*, 1932-33. (*Rpt. of Dpt. of Agr.*, 1932-33.) The cotton trials at Kpeve Station in Southern Togoland were continued. Yields were a record, and the improved Ishan maintained its reputation as a superior yielding cotton to Sonko, the local variety. In tests carried out on 20 half-acre plots cultivated by farmers in villages throughout the cotton-growing area, yields up to 696 lb. seed cotton per acre were obtained. In the course of a survey of the cotton-growing areas of Peki, Ve Deme, and Kpandu, the Agricultural Officers found that there was a demand for Ishan seed and for organized sale. In these circumstances a scheme was considered and approved whereby the Department will assist those farmers who wish to revive and increase cotton production. Propaganda was begun with a view to the formation of Cotton Growers' Co-operative Societies, and at the end of the year there were 15 prospective societies with a total of 192 farmers willing to co-operate. The farmers will grow Ishan cotton and sell conjointly; progress, however, is bound to be slow unless the price of cotton rises substantially.

At Tamale Station the Allen variety, D. 28, yielded 289 lb. seed cotton per acre in rotation, and ranged from 67 to 162 lb. in spacing and time of planting trials. The rainfall in the Northern Territories was the lowest for twenty seasons, and the plants suffered from drought, but D. 28 maintained its reputation as a good yielding strain.

347. NIGERIA. *The Tenth Ann. Bull. of the Agr. Dpt.*, 1931, recently received, contains particulars of various experiments with cotton carried out at Moor Plantation, Samuru, Ilorin, Kano, Yandev, and Maigana Seed Farm. The

experiments included rotation, manurial, varietal, time of planting, and growing cotton through yams.

348. EXPERIMENTS ON FARMING DETAILS AT MOOR PLANTATION, IBADAN, 1922-32. By J. L. B. Kincaid. The work done in connection with yams, maize, groundnuts, and cotton is described, and figures of costings are also included.

The results of experimental work on cotton indicated that the best variety to cultivate was Improved Ishan. Stands should be 2 feet apart on tops of ridges, or on side of ridges if through yams or maize. The seed rate should be 1 seed per hole (2-3 lb. per acre) by Balls' method, or 3 seeds per hole (5-8 lb. per acre) by ordinary method, thinned later to 1 plant per stand. Ridges should be 6 ft. apart.

349. THE ISHAN COTTON PLANT UNDER MIXED CULTIVATION—III. By E. H. G. Smith. (*Tenth. Ann. Bull. of Dpt. of Agr., Nigeria*, 1931, recently received.) An account of experiments on intercropping Ishan cotton with early maize. The results show that the stem height of Ishan cotton interplanted with early maize is at one time retarded by approaching 30 per cent. The recovery in the height of the intercropped cotton occurs both rapidly and comparatively early in the season. It is probable that the rapid recovery in the stem height of the intercropped cotton takes place when the rains recommence—that is, at the end of the short dry season. Intercropping with early maize does not affect flower production, boll production, and boll shedding, or yield. Bacterial disease (*Pseudomonas malvacearum*) and Helopeltis (*H. bergrothi*) are prevalent on Ishan cotton at Ibadan, and the latter appears to be of some importance.

Investigations were also carried out to determine the effect on Ishan cotton of intercropping with late maize. The experiment consisted of four plots of cotton alone (C), and three plots of cotton intercropped with late maize (L.M.C.). The following is a summary of the results: "The growth of the main axis of the intercropped cotton was not affected. The mean height of late maize varied from 94 to 101 per cent. of the mean height of cotton during the period of measurements. The cotton becomes thoroughly established before the maize is sown, and the competitive effect of the late maize is exerted too late in the cotton-growing season for the growth of the intercropped cotton to be influenced. Flower production, boll production, and yield are reduced by from 25-30 per cent. when cotton is interplanted with late maize. With flowering, this reduction occurs over the time of maximum flower production; with yield, the reduction was more severe during the first half of the harvesting period. The average plot yields of seed cotton for the two treatments, expressed as nominal yields per acre, were 490 lb. per acre for the cotton alone (C), and 360 lb. per acre for cotton intercropped with late maize (L.M.C.), a reduction of 26 per cent. The average yield of the four C plots was 55 decagrammes, and the average difference of the three L.M.C. plots was $11{\cdot}5 \pm 19{\cdot}6$ decagrammes, a difference of no statistical significance. Boll shedding was severe: 56 per cent. of the C bolls and 60 per cent. of the L.M.C. bolls were shed. Thus, there is some evidence that boll shedding is slightly affected by intercropping with late maize, and there is also evidence that boll shedding of the L.M.C. group is somewhat heavier than the C group early in the season, and that after the middle of the season the reverse occurs. Only an average of 49 per cent. of the late maize stands produced cobs at harvest, and many of the cobs were small. The remaining 51 per cent. of the maize stands either died before harvest or failed to produce cobs. The average yield of late maize from the intercropped plots was equivalent to a yield of 745 lb. of dry grain per acre, which is a low yield for a block of average fertility. The incidence of cotton diseases and pests was less severe than on the early maize and cotton

plot. Bacterial disease was less prevalent, but by the middle of November the attacks of Helopeltis had become general.

[*Cf.* Abstracts **443**, Vol. VII., and **536**, Vol. VIII., of this Review.]

350. NYASALAND: *Cotton Prospects*, 1933-34. A report from H.M. East African Trade and Information Office for the month of February states that the demand for seed is satisfactory, and early planting is more general this season. Drought conditions in cotton areas have necessitated a high rate of seed supply, and 1¼ million pounds have been issued on the Lower River.

351. *Cotton Cultivation*, 1933-35. (*Int. Cott. Bull.*, xii., **47**, 1934, p. 256.) It is expected that purchases from the 1933-34 crop will be equivalent to about 4,500 bales of 500 lb. The programme for the 1934-35 season includes measures for extending cotton growing in the districts traversed by the northern extension of the railroad, and the Department of Agriculture has done much to interest the natives in the growing of this and other exportable crops.

352. SOUTH AFRICA: *Cotton Cultivation*, 1932-33. (*Crops and Markets, S. Afr.*, January, 1934, p. 97.) Owing to the late rains, the adverse exchange position, and the low prices prevailing, there was a considerable reduction in the acreage planted during the season. Droughty conditions throughout the growing period reduced the crop still further, except in the Barberton area, where conditions were more favourable. Although little cotton was planted under irrigation, excellent early yields were obtained, and even in the most dry-land areas cotton gave some return, whereas other crops failed.

Bollworm was observed in most areas, but did little material damage except in Swaziland, where the infestation was considerable. Cotton stainer was reported to have strangely disappeared from some districts, where it had been a menace in past seasons.

Cotton Prospects, 1933-34 *Season*. Although planting was delayed owing to late rains, the improvement in prices and trade generally encouraged farmers to plant a larger acreage, and in those districts which have not been affected by the floods conditions have been favourable, and should they continue so, good crops may be expected.

353. *Cotton Industry*, 1933-34. (*Crops and Markets., S. Afr.*, March, 1934, p. 133.) The production this season is estimated at 2,127 statistical bales of 500 lb. Generally, conditions have been favourable, and damage by bollworms has not been unduly severe.

354. UGANDA: *Cotton Industry*, 1933-34. The latest report from the Department of Agriculture states that marketing of the crop has proceeded satisfactorily at prices of approximately Sh. 1/- per 100 lb. higher than those ruling last season. In most areas the grade is considerably higher than that of the last crop.

355. *Cotton Industry*, 1933-34. From the *Crown Colonist* of April we quote the following: " The cotton season has begun in earnest, and a large proportion of the crop east of the Nile has already been marketed, while the buying season on the west of the Nile has commenced. The grade of the cotton throughout is excellent, and is the best yet produced. Market prices are remaining on an excellent level, and the native growers are getting a very satisfactory price for their growth. In the Eastern province they have been receiving from 9 to 10 cents per lb., while this side they will receive from 12 to 13 cents. These prices have had a most stimulating effect on trade and the bazaars are busy. The Government legislation of zones is proving very effective, and the working of this system is proving satisfactory to the industry."

356. *Cotton Experiments.* (*Bull. of Imp. Inst.*, xxxi., **4**, 1933, p. 570.) According to a report on the experimental work carried out at the Serere Plantation from January to June, 1933, a spacing and seed-rate trial planted in 1932 was harvested. The experiment was designed to determine the better spacing of $4 \times 1\frac{1}{2}$ feet and 3×1 foot in June and July sowings, and also to determine the number of seeds per hole—3, 6, 9, or 12—required to give the best stand and yield. The results showed that the stand from the July sowings was significantly better than that from June sowings; there was no significant difference between the $4 \times 1\frac{1}{2}$ feet and 3×1 foot spacings; 9 and 12 seeds per hole gave the best stands; the interaction between seed rate and sowing date is significant.

A further experiment designed to ascertain whether it is possible to compensate for the lower yields of late plantings by closer spacings was commenced.

At the Bukalasa Experiment Station sowing date, spacing, and subsoiling experiments were carried out. The possibility of prevention of soil erosion and maintaining soil fertility by mulching with elephant grass was investigated. The layout consisted of 20 subplots of 10 rows each, with a spacing of 3×1 foot. The following results were obtained:

Mean Yield of Subplot in Lbs.	*First Quality Cotton.*	*Stained Cotton.*	*Total.*	*Per Cent. Stained Cotton.*
Control	39·13	3·77	42·9	8·8
Mulched	38·54	4·36	42·9	10·2

The results of this experiment are negative so far as yield is concerned. This was the first time that mulched cotton gave no increase in yield over the control. An interesting feature of the experiment was the fact that cotton from the mulched plots gave a 3 per cent. higher ginning outturn than that from controls.

357. WEST INDIES. SEA ISLAND COTTON. (*W. Ind. Comm. Circ.*, xlix., **926**, 1934, p. 125.) A brief history of the events which led to the formation of the West Indian Sea Island Cotton Association, with an Advisory Committee in London, and the part taken by the West India Committee in this movement for rationalizing the West Indian Sea Island cotton industry.

358. SEA ISLAND COTTON: CULTIVATION. (*Trop. Agriculture*, xi., **2**, 1934, p. 43.) "Increased areas have been planted to Sea Island cotton in Nevis and St. Vincent for the 1933-34 crop; the area planted is, however, within the limits agreed at the 1932 Cotton Conference. The 1932-33 cotton has now been reaped, and yields above the average were obtained. From an area of 2,182 acres a yield of 483,683 lb. of lint was secured, most of which has been sold."

359. GRENADA: *Cotton Cultivation*, 1932. (*Ann. Rpt. of Agr. Dpt. Grenada*, 1932, recently received.) In Carriacou selection work was continued with C. 1 and M. 1, the two most promising types. For all practical purposes M. 1 is as pure as it can be, and either strain can be used as a source of seed supply for commercial purposes. A plot of C. 1 yielded seed cotton at the rate of 1,452 lb. to the acre, with a ginning outturn of 23 per cent.; 133 bolls yielded 1 lb. of seed cotton compared with 200 for ordinary fine cotton. A plot of M. 1 yielded 1,513 lb. of seed cotton to the acre, the ginning outturn being 26 per cent. 125 bolls yielded 1 lb. of seed cotton.

Other experiments carried out during the year included: Spacing and number of plants to the hole, ridge *v.* flat cultivation, manurial trials, thinning of ratoon shoots, rotation experiments with cotton, corn, and pigeon peas.

The following cotton pests were encountered during the period under review, but did not cause serious damage: Cotton stainers, cotton worm, ***Heliothis obsoleta***, and pink bollworm. The loss of crop occasioned by pink bollworm was negligible.

Where punctured bolls were found they were generally of *Gossypium barbadense*; *G. purpurascens* showed greater resistance.

360. NEVIS: *Cotton Industry.* (*Trop. Agriculture*, xi., **4**, 1934, p. 85.) " A bonus of 3¼ cents per lb. of seed cotton has been paid by the Government in Nevis to peasants who brought their cotton to the Government ginnery last year. As the advance made at the time of ginning was 3 cents per lb., the total payment for the crop amounted to 6¼ cents per lb. The present crop is fairly promising, but the rainfall has been rather excessive."

361. ST. VINCENT: *Cotton Prospects*, 1933-34. A note on the cotton crop for the quarter ended March 31 received from the Acting Agricultural Superintendent, reads as follows: " The area returned as being under Sea Island cotton is 1,216 acres, and for Marie Galante 719 acres, which makes a total of 1,935 acres. Neither fungoid nor insect pests have done any appreciable damage. The percentage of stained cotton is small, except in a few inland localities. The yield per acre will be low, and is expected to be around 100 lb. per acre. This is mainly due to the abnormally wet weather conditions experienced at the end of last year."

362. AUSTRALASIA. QUEENSLAND: *Cotton Cultivation*, 1933-34. (*Int. Cott. Bull.*, xii., **46**, 1934, p. 160.) Good planting rains occurred at the end of September in nearly all the principal cotton-growing districts. The acreage was estimated at a little over 80,000 acres, or nearly the same as that of the previous season. At the beginning of October, just after the beneficial rains which fell at the end of September, general planting was made. The crop made an excellent start—in fact, the best start for years, and good stands were obtained.

363. QUEENSLAND: *Cotton Prospects*, 1933-34. (*Queens. Agr. Jour.*, xli., **3**, 1934, p. 307.) It is stated that the late February rains were urgently needed to develop the top crop of bolls, and a record yield for the state is anticipated. Excellent crops are expected from the Upper Burnett, and where proper cultural practices have been adopted, good yields from early-planted crops also are in prospect. An outstanding feature of the season in most districts is the freedom from attacks of corn earworm.

COTTON IN EGYPT.

364. COSTS OF COTTON PRODUCTION. (*The Egyptian Cotton Year Book*, 1932-33. Abstr. from *Int. Cott. Bull.*, xii., **46**, 1934, p. 190.) The following table gives the average cost of production per feddan for cotton in Egypt:

		P.T.
Cost of 1 sack chemical manure (fertilizer)...		100
Cost of seed for sowing	average	37·50
Ploughing (from 60 to 120 P.T. per feddan)	,,	90
Planting	,,	5
Weeding (6 to 10 P.T. per feddan)	,,	8
Chopping seedlings (6 to 8 P.T. per feddan)	,,	7
Three hoeings (40 to 45 P.T. per feddan)	,,	42·50
Waterings by gravity (if by elevating machinery add 40)	,,	40
Picking leaf worm (18 to 30 P.T. per feddan)	,,	24
Picking cotton (P.T. 20 per feddan) 4 kantars	,,	80
Uprooting cotton stalks	,,	9
Watchmen	,,	7·50
		450·50

1 feddan = 1·038 acres. 97½ P.T. = £1 sterling.

The above schedule of costs is based upon the average of five big estates, and the cost of ploughing includes the hire of a team of oxen and driver. In

Upper Egypt cost of irrigation is often much higher, but the yield per feddan is proportionately higher also.

The cost of production for small landowners is very much lower, since the owner and his whole family work in the field themselves, and the cost of hired labour is eliminated.

365. Agricultural Experimentation in Egypt. By J. Legros. (*Int. Rev. Agr.*, xxiv., 1933, p. 511. From *Plant Breeding Abstracts*, iv., **3**, 1934, p. 194.) Agricultural research in Egypt is under the control of various organizations, including the Botany and Plant Breeding Section of the Ministry of Agriculture, the Royal Agricultural Society and the Cotton Research Board. The work of the Botany and Plant Breeding Section situated at Giza relates mainly to cotton—the production of new varieties, the improvement of methods of cultivation, the selection of new strains, and the maintenance of direct contact with the important cotton growers.

The Cotton Research Board acts as a liaison organization between the various administrations concerned in cotton investigations. It thus provides a means whereby general consideration on broad lines of problems of cotton cultivation may be attained, and also new information and discoveries conveyed to those administrations that may be interested. A large library and a Laboratory Research Committee, including all research workers in the various laboratories, and the supervision of various publications reflect the activities of the Board.

366. Egyptian Cottons. By A. E. Gadallah. (*Leafl. No.* 4, Min. Agr. Egypt., 1932. From *Plant Breeding Abstracts*, iv., **3**, 1934, p. 178.) Under the two headings of Commercial Varieties and New Strains a short account is given of each of the existing varieties of Egyptian cottons. Plates showing types of bolls and seeds are appended.

367. The Competition of Artificial Silk with Egyptian Cotton. By N. S. Pearse. (*Int. Cott. Bull.*, xii., **47**, 1934, p. 317.) In many ways rayon has stimulated the demand for Egyptian cotton in the past, and it is still widely used in conjunction with this type of cotton in the weaving trade. Moreover, the influence of rayon has resulted in greater attention to quality in cotton dress fabrics. It may be of interest to mention that according to some experiments undertaken by the Serivalor Laboratories in Vienna " cotton is 120 times more durable than rayon."

368. Direct Transactions between Cotton Producers and Spinners. By Y. Bey Nahas. (*Int. Cott. Bull.*, xii., **47**, 1934, p. 305.) A suggestion that direct relations be established through the medium of the Banque de Crédit Agricole d'Egypte.

369. Production of White Cotton in Egypt. By W. L. Balls. (*Int. Cott. Bull.*, xii., **47**, 1934, p. 302.) Breeding work is being carried out to evolve really white cottons, for which there is a rapidly increasing demand for hosiery manufacture. In the meantime, a cotton (Giza 27) is available which is a good colour and a high yielder, and experimental cultivation of this is being undertaken.

370. Problems that Confront the Botanical Section (Giza, Egypt) in Respect of New Cottons. By J. Templeton. (*Int. Cott. Bull.*, xii., **47**, 1934, p. 303.) The introduction into the Delta of new cottons evolved by the Botanical Section is beset by difficulties, and the author quotes the case of Giza 7. Notes are included of other new strains which are superior to certain varieties still cultivated, and which are ready for propagation when required.

COTTON IN THE UNITED STATES.

371. Can America Retain Cotton Leadership? By C. Vinson. (*Int. Cott. Bull.*, xii., **47**, 1934, p. 277.) The author states that while America is decreasing her area under cotton, most of her foreign competitors are increasing theirs.

372. United States: *Cotton Acreage*, 1934. (*Int. Cott. Bull.*, xii., **46**, 1934, p. 169.) The cotton acreage reduction programme calls for a 40 per cent. reduction based on the average acreage planted from 1928 to 1932 inclusive. The average acreage planted for the five-year period is approximately 41,500,000 acres, and a 40 per cent. reduction will be necessary to bring the planted acreage down to the 25,000,000 mark for the 1934 crop. It is believed that the average cotton grower is willing to co-operate with the Government.

373. National Plans and the Cotton South. (*Texas Weekly*, Dallas. From *Int. Cott. Bull.*, xii., **46**, 1934, p. 178.) Discusses the question of the economic future of the people of the cotton-growing South.

374. The Bankhead Bill and its Potentialities. (*Int. Cott. Bull.*, xii., **47**, 1934, p. 271.) A concise description of the Bill and its possible effects upon the American cotton farmer, given by the National City Bank of New York in their monthly report for April.

375. The U.S. Economic Revolution. By W. Whittam. (*Text. Rec.*, li., **613**, 1934, p. 22.) Discusses industrial "codes" and tariffs.

376. Textiles in the United States: The Raw Cotton Situation. By W. Whittam. (*Text. Rec.*, li., **613**, 1934, p. 61.) Users of cotton in the industries are not as a rule disposed to pay very close attention to long-time trends. Yet, in the space of one generation, the share of American cotton in the total used by the world has declined from more than 75 per cent. to a proportion hovering around one-half. Ominous, too, for the future of United States growers, and the place cotton (the chief agricultural export) seems destined to take in international exchange of commodities, is the fact that the American Cotton Belt has been exporting its soil fertility for a century, with the result that vast areas of farm lands are now essentially useless, except at almost prohibitive cost for artificial fertilizers. Conventional reckless methods of cultivation have also denuded other great spaces of farm lands by encouraging soil erosion to the point where the top soil has been swept away, or has had the humus and other elements of fertility removed. So the inevitable long-time sequel is that foreign spinners will one day have to look elsewhere than the United States for a reliably ample supply of cotton having the spinnable qualities they need. Depleted soils impair both staple length and quality, as has been demonstrated by the decline in both these essentials during the last thirty years.

377. American Cotton Fabrics: Processing Tax Conversion Factors. (*Text. World.*, **83**, 1933, p. 2168. Abstr. from *Summ. of Curr. Lit.*, xiv., **4**, 1934, p. 106.) A table is given of conversion factors and "non-cotton contents" for the most important textile products as set up in supplementary regulations issued officially. Definitions of these products are also given. The "conversion factor" is the percentage of the per pound processing tax on cotton with respect to each pound of the cotton content. It has been developed officially for assessing additional duties on imported goods and rebating processing taxes on exported goods.

378. American Cotton Ginners: Marketing Agreement. (*Cotton Oil Press*, **17, 8**, 1933, p. 17. Abstr. from *J. Text. Inst.*, xxv., **3**, 1934, A159.) The cotton-ginners' marketing agreement under the National Recovery Act is set out, with

the definitions of terms used and particulars of the administration, books and records, service charges, cotton seed, trade practices, and sampling procedure to be adopted. In the preamble it is acknowledged that "there now exist . . . ginning methods which materially reduce the quality and lower the value of cotton, and trade practices which interfere with and obstruct the efficient handling and sale of cotton in domestic and world markets." The code aims to correct this.

379. AMERICAN TEXTILE MILL: BUDGETARY CONTROL. By D. J. Garden. (*Text. Mfr.*, **59**, 1933, p. 473. Abstr. from *J. Text. Inst.*, xxv., **3**, 1934, A159.) Budgetary control, comprising mainly the forecasting of sales, the planning of stock levels, and production in co-ordination with these forecasts, and the determination in advance of the expenditure which will be involved, all expressed in the form of definite schedules or programmes, has many advantages in textile works. The procedure adopted in an American textile mill is outlined, in which a budget is operated largely through a system of standard costs.

380. COTTON YARNS: COUNTS SPUN IN U.S.A. By G. G. Osborne. (*Cotton, U.S.*, 98, **1**, 1934, p. 23. Abstr. from *Summ. of Curr. Lit.*, xiv., **6**, 1934, p. 142.) Graphs and statistics are given relating to the quantity of yarn spun to certain ranges of counts in the Southern States and in New England. In the South, about 55 per cent. of the output is below 20's and 35 per cent. covers the range 21's to 40's. In the New England States, about 50-55 per cent. falls in the group 21's to 40's. The South is extending the spinning of finer counts at a greater rate than the North.

381. MISSOURI: *Field Crops Experiments.* By M. F. Miller *et al.* (*Miss. Sta. Bull.* 328, 1933. Abstr. from *Exp. Sta. Rec.*, 70, **2**, 1934, p. 172.) In connection with cotton, the following experiments were carried out: Varietal trials; fertilizer tests with cotton and pasture; and the effect of crop rotation on cotton yields.

382. TENNESSEE: *Field Crops Experiments.* By C. A. Mooers *et al.* (*Tenn. Sta. Rpt.*, 1932. Abstr. from *Exp. Sta. Rec.*, 70, **2**, 1934, p. 172.) Varietal, cultural, and fertilizer tests with cotton and other crops are described.

383. TEXAS: *Agronomic Research.* By E. B. Reynolds *et al.* (*Texas Sta. Rpt.*, 1932. Abstr. from *Exp. Sta. Rec.*, 70, **2**, 1934, p. 172.) Experiments briefly reviewed include varietal, breeding, and cultural tests with cotton; inheritance studies; effect of radiation on cotton and asexual propagation of cotton; seed bed preparation studies; seed treatment; fertilizer trials with crops in rotation, corn, wheat, oats, rice, peanuts, cotton, and potatoes; fertilizer experiments in control of cotton root-rot; harvesting, storage, and ginning experiments with cotton.

COTTON IN FOREIGN COUNTRIES.

384. ARGENTINA: *Cotton Cultivation*, 1933-34. (*Int. Cott. Bull.*, xii., **47**, 1934, p. 255.) The 1933-34 planted cotton acreage was officially estimated in January at 469,000 acres. This is larger than any acreage planted to cotton in Argentina in any previous year.

385. BELGIAN CONGO: *L'Agriculture Indigène dans l'Ubangi.* By G. Leontovitch. (*Bull. Agr. du Congo Belge.*, xxiv., **1**, 1933, p. 45.) The district of the Ubangi occupies 7,000,000 hectares in the north-west of the colony (next to French Equatorial Africa). The various sections of this paper deal with climate, communications, population, crops, markets, locust invasions, and cotton culture. The rotation of cotton with other crops is described.

386. BRAZIL: *Cotton Crop*, 1933-34. (*Int. Cott. Bull.*, xii., **47**, 1934, p. 255.) The crop in Northern Brazil is estimated at 90,000 metric tons according to official estimates. This figure is a decline of 12,000 tons from the first estimate.

387. BRAZILIAN COTTON: LENGTH FREQUENCY CURVES. By A. M. de Azevedo. (*Indus. Text.*, ii. **22**, 1933, p. 17. Abstr. from *Summ. of Curr. Lit.*, xiv., **7**, 1934, p. 187.) Frequency curves are given and discussed for cotton of the 1929 and 1932 crops of the states of Rio Grande do Norte, Parahyba, Pernambuco, and São Paulo, classified according to type and length.

388. SÃO PAULO: *Cotton Cultivation.* By J. G. Dantas. (*Indus. Text.*, ii., **18**, 1933. Abstr. from *Summ. of Curr. Lit.*, xiv., **7**, 1934, p. 171.) As a result of variety trials and selections the quality of the cotton has been improved in recent years, and the average staple length has been increased to about 28 mm. Internal demand and prices are good, and an export trade may develop as crops increase.

389. CHINA: *Revival of the Cotton Industry.* (*Int. Cott. Bull.*, xii., **48**, 1934, p. 211.) Definite action with a view to reviving the cotton industry in China was taken in October last by the establishment of the Cotton Industry Commission under the chairmanship of Mr. K. P. Chen, Managing Director of the Shanghai Commercial and Savings Bank. The main objects of the Commission are to increase the production of cotton in China and improve the quality, and also to provide better marketing, transport, and testing facilities. The commission consists of 21 members, representing spinners, bankers, and central and local Government officials.

390. ASSOCIATION COTONNIÈRE COLONIALE. *Bull. No.* 14 contains the following: "Un nouvel ennemi du cotonnier en Afrique Equatoriale Française, Helopeltis bergrothi, Reut." (A.P. Moreau); "La structure de la fibre de coton" (J. Szymanek and O. Röhrich); "Culture du coton en Syrie en 1933" (E. Achard). Notes on cotton in the French Colonies, cotton legislation, etc., are included.

391. ITALY: *Cotton Industry.* (*Int. Cott. Bull.*, xii., **47**, 1934, p. 375.) The cotton industry has been adversely affected by export difficulties and depreciated currency competition. Under normal conditions 38 per cent. of the total output is exported, but this has fallen to 30 per cent. Thorough reorganization of the industry is necessary, and the Italian Cotton Institute, founded by the manufacturers in 1912 to meet another depression, has been raised to the status of a corporation, to which all cotton and cotton-waste spinners are required to belong. The institute will regulate the output of yarn, facilitate the sale of cotton fabrics, regulate conditions for sale and payment of yarns, and facilitate purchase of raw material. Its decisions will be binding on the whole industry.

392. MANCHUKUO: *Cotton Industry.* (*Int. Cott. Bull.*, xii., **48**, 1934, p. 216.) A Japanese-Manchurian company, the Manchuria Cotton Manufacturing Co., has, it is reported, been formed with an initial capital of 1,000,000 yen, which, during the course of the present year, will bring two spinning mills into operation in Liaoyang and Taohoshan, the chief cotton region in Manchukuo. The objects of the company are to purchase and work up the whole of the crop of cotton in Manchukuo, amounting to some 20,000,000 lb., and to promote and supervise the cultivation of cotton in the country.

393. MANCHURIAN COTTON. Toyo Menka Kaisha, Ltd., Shanghai. (*Int. Cott. Bull.*, xii., **46**, 1934, p. 155.) Cotton is grown mostly in the southern part of Manchuria; it is chiefly used for hand spinning, bed quilts, etc., but has also been used in spinning yarns as high as 30's to 40's, according to experiments undertaken by the Mukden mill.

394. ROUMANIA: *Cotton Cultivation.* By A. Frigyes. (*Textil Lloyd*, viii., **3**, 1934, p. 15. Abstr. from *Summ. of Curr. Lit.*, xiv., **6**, 1934, p. 137.) The soil and climate of Roumania are both suited to cotton culture, and the industry is steadily

developing under Government protection. Plant pests and degeneration have not yet appeared, nor is artificial fertilization necessary. The greatest proportion of the fibres (31 per cent.) are 24-28 mm. long, and the colour is a pure lustrous white. At present the cotton is chiefly used in the manufacture of wadding. Particulars are given of the various regions and yields.

395. RUSSIA: *Cotton Production*, 1933. (*Int. Cott. Bull.*, xii., **46**, 1934, p. 163.) It is stated in a Tass Agency message that 1,250,000 tons had been harvested by December 20, which is over 100,000 tons in excess of the previous year's crop. It is planned to effect a considerable increase in the crop next year, and for that reason the cotton districts of Middle Asia and the Transcaucasus will be supplied with greatly increased quantities of mineral fertilizers.

396. STAND UND AUSSICHTEN DES BAUMWOLLBAUS IN DER SOVET-UNION. By A. Melkich. (Pubd. by Paul Paret, Berlin, 1933. From *J. Text. Inst.*, xxv., **3**, 1934, p. 20.) This brochure, as the title suggests, is the result of an investigation into the present position and prospects of cotton cultivation in the Soviet Union. The desire of the Soviet Government to make itself independent of foreign cotton has led to a considerable increase in the cultivation of cotton in Russia, which has produced technical and economic problems which are the subject of the present investigation. The whole question is thoroughly discussed in the first place from the point of view of the five-year plan. Then the different ways in which the increased production has been achieved are described, and its effect on other branches of agriculture. The difficulties attendant on the introduction of new machinery and methods are outlined, and, finally, the economic problems are orientated. The information given appears to be without political bias and should therefore be very useful to anyone studying the position of cotton in the present state of world economics.

SOILS AND MANURES.

397. IMPERIAL BUREAU OF SOIL SCIENCE. (*Rpt. for the Year ended March* 31, 1934.) A report of a year of useful work. Approximately 2,500 papers were entered in the index, which now contains 40,000 cards; 357 reprints were added to the loan collection, and 4 technical papers were published. A third Congress of Soil Science will be held in Oxford in July and August, 1935.

398. SOIL, VEGETATION AND CLIMATE. (*Tech. Commn. No.* 29, *Imp. Bur. of Soil Sci.*, 1934.) This publication from the Imperial Bureau of Soil Science, Harpenden, should be in the hands of those who have to do with soils. After an introductory discussion, the subject is dealt with under the following headings: Climate and Pedology; The Significance of Vegetation in the Study of Soil Types; Definition of Soil; The Climatic Classification of Genetic Soil Types; The Distribution of the Main Genetic Soil Types; General Description of Soil Types; Soil-vegetation Types in relation to Climate; Intrazonal Soils; Soil Classification; the American System of Soil Classification; Gedroiz's Classification of the "Soil Absorbing Complex"; Soil Differentiation by the Silica-Alumina Ratio of the Clay. The authors hope that the paper, dealing with what at present is a more or less inchoate science, will provide food for thought and perhaps also for controversy.

399. THE ANALYSIS OF SOILS: DEVELOPMENT OF NEW METHODS. By G. W. Robinson. (*Times Trade and Eng. Supplmt.*, March 3, 1934.) In this useful paper the author states that the significance of soil analysis has undergone a change in recent years through the general recognition of soil science, more conveniently termed pedology, as a branch of pure science. An excellent account

is given of the much more complicated methods that have now to be employed, and of the valuable and applicable results which they produce.

400. SOILS AND FERTILIZERS. By E. M. Crowther. (Reprinted from *Rpts. of the Progress of Applied Chemistry*, xviii., 1933.) A useful review of the progress made during the year in the study of soil science. The various sections deal with the following: The Minerals of Soils and Clays; Ionic Exchange and the Structure of Silicates; Physical Analysis of Soils; Soil Organic Matter; Physiological Aspects of Nutrient Uptake; The Availability of Soil Phosphoric Acid and Potassium; Fertilizers, including Nitrogenous, Phosphatic, Potassium, Lime and Magnesia, Organic Manures; Weed Killers; Methods of Analysis of Soils and Fertilizers.

401. THE ASPERGILLUS NIGER METHOD OF MEASURING AVAILABLE POTASSIUM IN SOIL. By A. Mehlich *et al.* (*Soil Sci.*, 35, **4**, 1933, p. 259. Abstr. from *Exp. Sta. Rec.*, 70, **1**, 1934, p. 23.) Of two strains of *Aspergillus niger*, one of them from a culture used by the originator of the Niklas method, the other a stock culture of the Wisconsin Experiment Station, from which this paper is contributed, both gave satisfactory results. Some other strains of the same species did not show a sensitiveness to potassium deficiency sufficient to make them useful in soil testing. With the use of a suitable strain of the organism, however, the method was found applicable for the quantitative estimation of potassium availability, either by the analysis of the mycelium "or more conveniently by interpolation of the weight of the mycelium on a curve which has been especially constructed for this purpose." The results compared favourably with those of chemical tests of the Neubauer and of other methods. "It is concluded that the test is simple and reliable and may be used in a practical way for the determination of potash needs of soils."

When the calcium carbonate content of the soil exceeded 1 per cent. (a simple method for determining soil calcium carbonate), the addition of acid sufficient to give a pH value optimal for mould spore germination and adequate to prevent bacterial growth became necessary. Various calcium, magnesium, and sodium salts, the anions associated with the potassium, and "minor soil constituents and stimulants," did not interfere seriously with the results.

402. A COMPARISON OF VARIOUS METHODS FOR DETERMINING THE FERTILIZER NEEDS OF CERTAIN SOILS. By F. B. Smith *et al.* (*J. Amer. Soc. Agron.*, 25, **6**, 1933, p. 383. Abstr. from *Exp. Sta. Rec.*, 70, **1**, 1934, p. 21.) The authors of this contribution from the Iowa Experiment Station estimated the fertilizer needs of a Carrington loam soil by means of biological, chemical, and greenhouse test methods. They found, in part, that applications of sodium nitrate alone gave slight increases in the crop yield and brought about an increase in solubility of the soil phosphates; that 20 per cent. superphosphate gave increases in crop yields which varied directly with the amount of the application; and that applications of muriate of potash had no significant effect on crop yields on this particular soil.

"The growth of *Aspergillus niger* was closely correlated with the amount of available phosphate as measured by the Truog method. There was also a direct relationship between the amount of available phosphate and the crop yield. In general, the results secured with the *A. niger* method, the Neubauer test, and the Truog method for available phosphate, agreed rather closely with the crop yields obtained in both greenhouse experiments. That is, increased crop yields were secured on those soils containing the larger amounts of available phosphate. The Carrington loam, under the conditions of this experiment, seemed to be adequately supplied with available nitrogen and potassium, but showed a deficiency in readily available phosphate for maximum plant growth."

403. METHODS FOR THE DETERMINATION OF THE FERTILIZER REQUIREMENT OF THE SOIL—I., II. (Trans. title.) (*Meddel. Centralanst. Försöksv. Jordbruksomrddet (Sweden), Nos.* 419 *and* 428. Abstr. in *Exp. Sta. Rec.*, 70, **1**, 1934, p. 20.) I. *The Mitscherlich and Neubauer Methods in Comparison with Field Experiments*, by G. Sundelin *et al.* II. *Egner's Lactate Method and Arrhenius' Citric Acid Method for determining the Phosphate Fertilizer Requirement as compared with Field Fertilizer Experiments*, by O. Franck.

404. ELECTRODIALYSIS COMPARED WITH THE NEUBAUER METHOD FOR DETERMINING MINERAL NUTRIENT DEFICIENCIES IN SOILS. By P. H. Brewer and R. B. Rankin. (*J. Amer. Soc. Agron.*, 25, **6**, 1933, p. 414. Abstr. from *Exp. Sta. Rec.*, 70, **1**, 1934, p. 21.) The authors find, in part, that the Neubauer and electrodialysis methods both give results agreeing more closely with those of pot and field plat experiments in the cases of some soils treated with heavy applications of phosphate rock than did the figures yielded by extraction with 0·2 N nitric acid and other purely chemical extraction methods. The Neubauer and electrodialysis methods gave closely agreeing results in the cases both of soils given heavy applications of phosphate rock and of soils given relatively large applications of superphosphate.

"One feature which commends the electrodialysis method is the relatively short time from the beginning of the dialysis until the determinations may be completed. Such period need not exceed 8 hours for the P_2O_5 determinations or 12 hours for the K_2O determination.

"The similarity of the amounts of potassium and phosphorus extracted by the two Bradfield cells when operating upon equal quantities of the same soil was in most cases quite remarkable. This was particularly true of potassium. The greatest variation in K_2O between any two duplicate dialyzates was 3 mg., while the majority varied less than 1 mg. of K_2O."

405. THE RATES OF REACTION WITH ACID SOILS OF FINELY DIVIDED SOIL LIMING MATERIALS. By W. H. Metzger. (*J. Amer. Soc. Agron.*, 25, **6**, 1933, p. 377. Abstr. from *Exp. Sta. Rec.*, 70, **1**, 1934, p. 24).

406. SOIL MICROBES AND SOIL FERTILITY. By P. Kamerman. (*Farming in S. Afr.*, ix., **94**, 1934, p. 12.) A study of the microbiology of South African soils as a test for fertility.

407. THE ECONOMY OF SOIL NITROGEN UNDER SEMI-ARID CONDITIONS. By H. H. Finnell. (*Exp. Sta. Bull. No.* 215, 1933, Agr. Exp. Sta., Oklahoma.) Annual analyses of topsoil nitrogen on 22 plots for periods of seven or eight years show that trends of topsoil nitrogen varied according to crop practice between the extremes of average annual losses of 38·08 lb. of nitrogen per acre and gains of 5·74 lb. per acre. In cropping systems using various combinations of wheat and fallow, the nitrogen losses from topsoil were roughly in proportion to the extent of fallowing employed. Topsoil nitrogen losses averaged more where wide spacing of the crop was used than where close spacing was used. Under continuous wheat, Sudan hay and closely-spaced milo, the topsoil nitrogen was maintained with slight gains. A laboratory study of the soil in question indicated a nitrogen fixing flora, the activity of which was slightly increased by the addition of straw during an incubation period of two years. After eight years of diverse field management the balance of residual nitrogen was approximately the same in the 6-foot soil section of plots intensively cropped as in comparable crops lightly cropped. Continuous cropping resulted in the concentration of total nitrogen nearer the surface than did systems employing summer fallowing. All trends observed indicated that permanent losses of nitrogen from the root zone by leaching were increased by fallowing. The balances of

total nitrogen in the soil, added to increased yields of nitrogen in crops removed, gave intensive cropping an annual advantage in net nitrogen economy of from 15 to 30 lb. of nitrogen per acre over fallow cropping.

408. THE CALCIUM-MAGNESIUM RATIO IN SOILS AND ITS RELATION TO CROP GROWTH. By F. Moser. (*J. Amer. Soc. Agron.*, 25, **6**, 1933, p. 365. Abstr. from *Exp. Sta. Rec.*, 70, **1**, 1934, p. 23.) A report of a study of soils used in a cylinder experiment in which there were wide differences between the total and the replaceable content of calcium and magnesium, and the total amount of calcium and magnesium had no influence upor the amount held in replaceable form. The calcium-magnesium ratio, based on milli-equivalents, of these soils varied from 0·23 : 1 to 2·50 : 1 when based on total content, but the ratios were from 1 : 1 to 4·50 : 1 when based on the replaceable amount. No significant correlation between the calcium-magnesium ratio and crop yields was found; the significant factor in determining yields was the quantity of active calcium in the soil.

The beneficial effect of adding lime to a soil was found due not to an alteration of the calcium-magnesium ratio but to an increase of the replaceable calcium content of a soil. "The increase of the replaceable cation content of any soil seemed to be determined largely by the type of carbonate added. Pure magnesite markedly increased the replaceable magnesium content with no appreciable effect on replaceable calcium, while pure calcium carbonate increased only the replaceable calcium content. However, the limestone added to the cylinder experiment increased slightly the replaceable magnesium, but some magnesium was accidentally carried as an impurity of the limestone. The study of the lysimeter soils gave results similar to those obtained in the cylinder experiment, namely, there was no correlation between the total, the replaceable, and the water-soluble calcium and magnesium of a soil."

409. SOIL REBUILDING AT THE RED PLAINS EROSION STATION, OKLAHOMA. By S. W. Phillips. (*Jour. Amer. Soc. Agron.*, 25, **5**, 1933, p. 346. Abstr. from *Exp. Sta. Rec.*, 69, **4**, 1933, p. 497.) The experiments reported upon have been carried out co-operatively by the U.S. Dept. of Agriculture, Bureaux of Chemistry and Soils and of Agricultural Engineering, working with local agencies. The investigation included work at this station, near Guthrie in Central Oklahoma, on erosion and run-off rates and fertility losses, on vegetative and other means of control, and on the reclamation of eroded soils.

A continuous cotton plat lost four times as much soil as did a plat in sweet clover, cotton, and wheat rotation. A Bermuda grass plat lost only about 2 per cent. of the precipitation moisture and almost no soil. A fallow plat, though it lost about twice as much moisture, lost about 10 per cent. less soil than did a corresponding cotton plat. Cotton on clay subsoil about doubled the run-off and erosion loss of cotton on topsoil. Closed-end terraces in Vernon fine sandy loam saved much moisture but caused standing water damage to the crop on the terraced channels, while graded terraces effected no considerable saving of moisture, and were of practical effectiveness only for soil conservation.

Of certain of the experiments on erosion control through cropping practices, the following statements are made: "Four 1-acre fields (4 per cent. slope) were put into strip cropping this year. The cotton was li·ted (bedded) in on the contour, and the thick-growing, soil-saving strips were planted to oats and Sudan grass. The row crop and soil-saving strips each occupy approximately half of the land. With one of the most intense rains (May 31, 1932) since the establishment of this station, it was observed that this method of farming almost completely stopped soil losses and very largely diminished run-off. . . . Bermuda grass dams have proved effective in the control of small gullies, but some farmers

object to starting this persistent grass anywhere on their lands. With a light application of superphosphate sweet clover has caught very well in an experiment dealing with a large gully, and shows promise of being a useful means of controlling these major ravines. Subsoiling has not as yet shown any profitable increase in yields, but the experiments are being continued in order to determine definitely the full significance of this tillage method."

410. Soil Erosion: Causes and Methods of Control. By H. B. Roe. (*Minn. Univ. Agr. Ext. Spec. Bull.* 160, 1933. Abstr. from *Exp. Sta. Rec.*, 70, **2**, 1934, p. 252.) Practical information is presented on the subject. It has been found that sheet erosion is the most harmful type, and that the important contributing causes of erosion are certain current farming practices. The ultimate method of sheet erosion control is that of terracing practically all cropped slopes subject to erosion, coupled with cover cropping and contour cultivation. The best type of terrace for general use is considered to be the standard graded Mangum terrace. Crop rows may be run diagonally across the terraces, but contour planting and cultivation approximately parallel to the terraces are an effective aid in controlling sheet erosion and are recommended.

411. La Fumure du Cotonnier en Egypte. By C. R. Shabetai. (*Coton et Cult. Cotonn.*, viii., **2**, 1933, p. 65.) The average cotton crop attained its maximum (5·80 kantars per feddan) in 1897, and fell afterwards, the fall being more rapid after 1914. The minimum was in 1921 (2·56 kantars per feddan), and in 1929 the yield was 3·63 kantars.

It is not easy to decide the exact causes of this fall in yield, and the question arises to what extent manuring can improve matters. The work described here goes to show that a nitrogenous manure is an advantage, and if that is given, further improvement may also be obtained with a phosphatic manure.

412. Agricultural Wealth from Waste: Activated Composts. By R. D. Anstead. (*Trop. Agriculture*, xi., **3**, 1934, p. 69.) An account of the processes for making good organic manures from refuse of all kinds. The subject is dealt with under the following headings: Vitamins; Activated Sludge Process; Sewage Utilization; Town Refuse; Activated Composts; Method of Preparation; Value of Activated Composts.

413. Agricultural Utilization of Urban Refuse by the "Zymos" Process. By M. J. Bordas. (*Vie agricole et rurale*, **15**, 1933. Abstr. from *Int. Rev. Agr.*, xxiv., **12**, 1933, p. T521.) An account is given of a French process which has been in use for some years in certain towns in south-east France, for treating all the town refuse (household waste, sewage, slaughterhouse waste, and road sweepings) in such a way as to produce a sterilized farm mould. The refuse is tipped automatically into silos in which it undergoes, in the required conditions of aeration, moisture and bacterial inoculation, biochemical reactions which in less than a month decompose it into humus. The gases are recovered and deodorized. Refuse which in the first stages of fermentation has for over three weeks been submitted to a moist temperature of upwards of 75° C. is thoroughly sterilized. During storage it undergoes less active fermentation, and then after sorting and milling it is delivered to the farmers. The product is a blackish, odourless, and slightly moist mould with an alkaline reaction. Its value as fertilizer is about twice that of a good stable manure.

414. The Azotobacter Plaque Test of Soil Deficiencies applied to some Indian Soils. By N. V. Joshi and C. S. R. Ayyar. (*Ind. J. Agr. Sci.*, iv., **1**, 1934, p. 166.) The azotobacter plaque method, according to Sackett's technique, has been applied to eight Indian soils. Until the minimum quantities of potassium and phosphoric acid necessary for the growth of azotobacter are correlated with

the needs of these minerals to plants in the soils to be tested, great care will have to be exercised in interpreting the results. It is indicated that the plaque method may prove useful in distinguishing between the availability of different phosphatic fertilizers. There is also a possibility of the method being useful in testing the acidity of a soil and finding out its lime requirements.

CULTIVATION, IRRIGATION, GINNING, USE OF SEED, ETC.

415. THE QUESTION OF ARTIFICIALLY INDUCING MATURITY IN COTTON. By A. M. Malzev. ("New Methods of Cotton Culture," pubd. by NIHI, Moskow and Tashkent, 1933, p. 40. From *Plant Breeding Abstracts*, iv., **3**, 1934, p. 226.) The use of ethylene in bringing unripe fruits of many plants to maturity is discussed. Experiments are then described in which immature cotton bolls (40-50 days) were subjected to ethylene treatment, two controls being dried in the sun and left on the tree respectively. No positive effect of the ethylene was detected in the weight of the fibre, weight of seed, or size of bolls, nor in the germinating power of the seeds, and in the majority of cases the ethylene treatment gave results even inferior to that of sun-drying.

416. THE EFFECT OF HEAT ON SEED COTTON. (*Int. Cott. Bull.*, xii., **47**, 1934, p. 280.) The results of experiments carried out by Government botanists in Texas indicated that: (1) The piling into heaps in the field of cotton which had not fully matured, and which contained a high percentage of moisture in the form of green leaves and green unopen bolls, resulted in damage to the cotton by heating at both College Station and Lubbock, the highest temperature recorded on the inside of the heaps being 133° and 149° F. respectively. (2) Well-matured, hand-snapped cotton stored in the field in heaps at Lubbock sweated slightly, but apparently was not damaged by heating. (3) The germination power of cotton seed was destroyed, and the fat content lowered when the seed was subjected to excessive heating. (4) The heating of cotton in bulk lowered the grade of the lint one to four grades, and caused a loss of 31-35 per cent. in the strength of the fibre. (5) The stage of maturity of the seed and lint, rather than the use of machinery in harvesting, was the main factor in causing the cotton to heat when bulked in large piles in the field. It is stated that in harvesting cotton mechanically, the cotton should be dry and practically free of green leaves and green unopen bolls, and it should not remain on damp ground for any great length of time prior to ginning if damage is to be avoided.

417. SOWINGS OF COTTON SEED CHEMICALLY DELINTED BY STRONG SULPHURIC ACID. By V. Stets. (NIHI, Moskow and Tashkent, 1933. From *Plant Breeding Abstracts*, iv., **3**, 1934, p. 226.) The treated seeds germinated better and earlier (by 2-3 days) than untreated, and the method has many other advantages.

418. RESULTS OF EXPERIMENTS WITH BIONTIZATION OF COTTON SEEDS. By D. V. Kharkov. ("New Methods of Cotton Culture," pubd. by NIHI, Moskow and Tashkent, 1933. From *Plant Breeding Abstracts*, iv., **3**, 1934, p. 226.) The author failed to observe regular and significant stimulating effects of various chemicals such as have been reported by other investigators. Some experiments gave slightly positive yield differences, others negative, and the majority showed no effect of the stimulant whatever. The author counsels caution in drawing conclusions from experiments of this kind. Above all, it is essential to work with pure line material and to have an adequate system of controls.

419. COMMERCIAL SELECTED COTTON VARIETIES. By Z. M. Pudovkina. (NIHI, Moskow and Tashkent, Central Breeding Station, 1933. From *Plant Breeding Abstracts*, iv., **3**, 1934, p. 224.) It is desired to raise the yield of cotton by 75 per

cent. during the second Five-Year Plan, without deterioration in fineness, torsion and strength of fibres, and with an increase, if possible, in lint length. From these points of view descriptions are given of the main varieties in cultivation, together with a number of new varieties capable of replacing them. The type of growth, leaf, flower, boll (including weight of lint), seed, lint characters such as colour, length and ginning outturn, and agronomic characters such as yield, earliness, resistance to drought and disease, are indicated first for the main Egyptian cottons, and then for certain new selections of Egyptian cotton, produced by NIHI. These include a Pima selection earlier than Pima by 3-7 days, outyielding it by 20-35 per cent., and giving a greater ginning outturn by 4-7 per cent., and lint 36-38 mm. in length; another Pima selection outyielding the original by 30 per cent. and otherwise of similar quality; a selection of Boss giving 50 per cent. higher yield of lint than Ashmouni; and a Pima selection with a very long lint, 1-2 days later in maturity than Ashmouni, which it outyields by 13 per cent. There follow similar descriptions of new ultra-early Upland selections made by NIHI from the variety Schroeder, and from various commercial mixtures, and of a number of mid-early and mid-late selections and hybrids. By reference to a group of high-yielding American varieties the possibility of combining high yield with high ginning percentage and long staple is illustrated. This group, referred to as "the 8,000's," has been produced by the Central Breeding Station from various American varieties, and they are being rapidly multiplied to replace Navrotskii. Descriptions are given of certain Upland hybrids which combine especially long staple with large boll and a fair degree of earliness. The varieties which it is proposed to cultivate in the different regions in the second Five-Year Plan are indicated in a table.

420. FIELD PROPAGATION OF COTTON BY THE MEANS OF GRAFTS. By H. E. Rea. (*Plant Physiol.*, 8, **1**, 1933, p. 171. Abstr. from *Exp. Sta. Rec.*, 70, **1**, 1934, p. 40.) The high percentage of successful grafts obtained by the Texas Experiment Station with field grafts of Lone Star cotton made from 1 to 10 p.m. and from 4 to 11 a.m. on September 18 to 22 inclusive, with a temperature range of from 68° to 93° F., showed that cotton can be grafted successfully under a wide range of field temperatures.

421. A STATISTICAL STUDY OF THE GROWTH OF THE MAIN STEM IN COTTON. By M. Afzal and S. S. Iyer. (*Ind. J. Agr. Sci.*, iv., **1**, 1934, p. 147.) *Summary.* Exponential curves of the form $H = Ae^{bT}$ have been fitted to height measurement data of cotton covering a period of seven years, and a comparison of the values of b or the "efficiency index" made. American varieties have numerically less relative growth rate than the Desi variety Mollisoni. The values of b estimated for Punjab cottons compare favourably with those found by Heath for South African varieties grown at Barberton. Full statistical details are given for fitting the curve and for comparison of two values of b by the method of pooled variances. There is a high coefficient of correlation between the value of b and the average relative growth rate for the whole period of growth.

422. COTTON PLANT: EFFECT ON SOIL PROPERTIES. By C. A. Khorikov. (*Pedology*, xxviii., 1933, p. 318. Abstr. from *Summ. of Curr. Lit.*, xiv., **7**, 1934, p. 171.) Perennial culture of cotton under artificial irrigation produced an increase in the clay content of the soil. Water-soluble salts (containing SO_4 and Cl) are leached out, and adsorbed potassium and sodium are replaced by calcium and magnesium. Humus, nitrogen, and available phosphate contents decrease.

423. COTTON PLANT; INFLUENCE OF SOIL MOISTURE ON YIELD. By S. A. Kudrin and S. V. Nemilovsky. (*Chem. Social. Agr.*, i., **2**, 1932, p. 72. Abstr. from

Summ. of Curr. Lit., xiv., 7, 1934, p. 171.) Soil-moisture conditions are only of importance when the nutrient content is low. The moisture content should be about 22 wt.-per cent. just before fluorescence, and 23-30 per cent. during flowering. Pot-culture methods are satisfactory for determining the manurial requirement of cotton.

424. The Effect of Irrigation on Soil Salts at the Gezira Research Farm, Wad Medani, Sudan. By H. Greene and the late R. H. K. Peto. (Reprinted from the *J. of Agr. Sci.*, xxiv., 1, 1934.) In order to ascertain whether subsoil salts moved upwards under the influence of irrigation an elaborate investigation was carried out at the Gezira Research Farm, Medani. It was found that the small apparent changes which occur under normal irrigation and cultivation are largely due to swelling and shrinking of the surface soil occasioned by changes in moisture content, and to mechanical disturbance and settling which depend on cultivation. Apart from these apparent changes, there may be a small downward movement of salt through the soil material; there is no upward movement. When the salt content of the surface soil is increased by application of soil improvers, or by other means, rains and watering rapidly wash down the salt and in the course of time the soil column returns to its normal profile. Salts introduced by the irrigation water are also washed down from the surface layers. The observations recorded show an increase in the average salt content of a 6 ft. column of soil which is roughly equivalent to the amount of salt introduced (about 1 ton per acre per 3 years).

425. Pima-Egyptian Cotton in Irrigated Rotations at the Yuma Field Station, Bard, California. By S. H. Hastings and E. G. Noble. (*U.S. Dept. Agr., Tech. Bull.* 369, 1933. Abstr. from *Exp. Sta. Rec.*, 70, 2, 1934, p. 176.) Rotations begun in 1923 to determine the best sequence and the effects of fertilizers, manure, and soil improvement crops on maintenance or improvement of cotton yields are reviewed for the periods 1923-26 and 1927-30. Information is given on the status of crops on the Yuma Reclamation Project, on the soil, climate, and cultural practices, and on the relative merits of Pima Egyptian and Upland cottons.

Maximum cotton yields in both periods were from a plat continuously cropped and manured, and the lowest yields were from a three-year rotation of cotton (sweet clover), grain sorghum, barley (sweet clover), and corn. Alfalfa increased cotton yields in every case over simple rotations omitting this crop, better results being obtained when the last year of the alfalfa was pastured instead of cut for hay. Inclusion of green manure crops, as vetch, clover, and cowpeas in the rotation, or applications of commercial fertilizer, did not influence cotton yields materially. Relatively close spacing of plants in the row resulted in slightly higher yields of seed cotton per acre than wider spacings. Indications were that, on productive land in the lower Colorado River region, Pima cotton may prove more profitable than Upland cotton.

426. Rotations in the Tropics. By R. C. Wood (*Trop. Agriculture*, xi., 2, 1934, p. 44.) In this paper Professor Wood deals with the questions of mixtures of crops and of rotations, and the advantages that the former system offers to the small cultivator are clearly pointed out. He then deals briefly with a few representative rotations which are adopted in the tropics. A useful paper for those beginning such work.

427. Harvesting Cotton. By R. W. Peters. (*Queens. Agr. Jour.*, xli., 3, 1934, p. 256.) Discusses the correct time to harvest the crop; the evils resulting from delayed picking; snapping; methods of packing and forwarding; grading.

PESTS, DISEASES, AND INJURIES, AND THEIR CONTROL.

428. Insect Pests and Related Matters. (*45th Rpt. S. Carolina Exp. Sta.*, 1931-32. Abstr. from *Rev. App. Ent.*, xxii., Ser. A, **2**, 1934, p. 70.) O. L. Cartwright reports that in experiments against the corn earworm (*Heliothis obsoleta*), in view of the damage caused to sweet maize in gardens, 1-3 applications of lead arsenate dust gave 60-80 per cent. control in the field, 87·6 per cent. of the ears on untreated plants being damaged. More adults of the cotton boll weevil (*Anthonomus grandis*, Boh.) emerged from hibernation in cages placed in a sheltered ravine than in those in an exposed situation on a hill, and oak leaves and pine needles gave better protection in the cages than maize stalks. An average of 11·6 per cent. of all the weevils placed in the cages in October, 1931, emerged.

It is stated by J. G. Watts that, though sprays of nicotine and pyrethrum show promise against thrips on seedling cotton, the application is so costly that control is best obtained by cultural methods. The crop should be planted as far from small grains as possible, all green vegetation having been turned in about two weeks previously, and vigorous growth should be maintained. Early and frequent cultivation will accelerate growth and destroy a certain number of the thrips, particularly the pupæ. *Frankliniella fusca*, Hinds, *Thrips tabaci*, Lind., and *F. tritici*, Fitch, are the most important species; they completed their life-cycles in 18·5, 15·01 and 16·3 days respectively under identical conditions.

F. Sherman reports that a loss of 3-7 per cent. of tomatoes is normally caused by the tomato fruitworm (*Heliothis obsoleta*), against which a liquid poisoned Bordeaux spray has given the best average results over several years.

429. The Changed Status of some Insect Pests in Porto Rico. By G. N. Wolcott. (*J. Dpt. Agr. Puerto Rico*, 17, **3**, 1933. Rio Piedras, Puerto Rico. Abstr. from *Rev. App. Ent.*, xxii., Ser. A, **3**, 1934, p. 154.) *Platyedra* (*Pectinophora*) *gossypiella*, Saund., and *Cosmopolites sordidus*, Germ., which appeared almost simultaneously in Porto Rico in 1921 on cotton and bananas respectively, now occur in practically every locality where their food-plants are present. Cotton planted by coffee-growers in an attempt to recoup themselves for losses caused by the hurricane of 1928 suffered from increasing infestation by *Alabama argillacea*, Hb., and *P. gossypiella*, which involved almost the whole crop for 1931-32. The growing of cotton was then abandoned, and the numbers of cotton insects dwindled, particularly as the hurricane of 1932 eliminated almost the only important alternative food-plants along the north coast; but *P. gossypiella* still persists wherever self-sown cotton occurs.

430. L'Infection chez les Insects. Immunité et Symbiose. By A. Paillot. (Trevoux, 1933. Abstr. from *Rev. App. Mycol.*, xiii., **2**, 1934, p. 93.) This book, which contains many original illustrations, is divided into seven parts, of which the first four deal with the diseases caused by protozoa, fungi, viruses, and bacteria; the fifth with anti-bacterial immunity; the sixth, with the phenomenon of bacterial symbiosis in aphids; while the seventh sets forth all the economic consequences of the investigation of infectious pathology among insects, with special reference to the rôle of the latter in the transmission of infective agents, and to the utilization of microbial parasites in the campaign against agricultural pests.

431. Barbados: *Pink Bollworm Infestation.* (*Trop. Agriculture*, xi., **4**, 1934, p. 85.) The Director of Agriculture states that in spite of a vigorous clean-up and a four-months close season there is considerable infection by pink bollworm in the present crop. It is suggested that a careful investigation should be made with regard to the incidence of this pest in the various cotton islands during the present season, in order that the situation may be discussed at a future meeting of the West Indian Sea Island Cotton Association.

432. Corn Earworm (*Heliothis obsoleta*) Studies. By L. P. Ditman and E. N. Cory. (*Maryland Sta. Bull.* 348, 1933, p. 525. Abstr. from *Exp. Sta. Rec.*, 70, 1, 1934, p. 66.) The authors report the results of work conducted in 1932 on the corn earworm as a pest of sweet corn, followed by observations of husk characteristics and their relation to injury by corn earworm, results of preliminary experiments on the reaction of the moths to lights, studies on the nutrition of the moths, the repellency of several materials, and the attractiveness of sweet baits in the field. A general discussion of the control of the pest is given with present recommendations, which include: fall ploughing, early planting, and the selection of resistant varieties.

433. Results of Two Years' Work with an Attractive Spray for Corn Earworm Moth (*Heliothis obsoleta* Fab.) By R. C. Burdette. (*J. Econ. Ent.*, 27, 1, 1934, p. 213.) Syrline, an invert sugar syrup, was found to be attractive to the corn earworm moth, and attempts were made to render it poisonous also by adding tartar emetic. The latter, however, did not operate quickly enough to prevent egg-laying, and attempts will be made to discover a faster acting poison.

434. Cotton Aphids in Transcaucasia. Studies on Biology and Control. By V. N. Rekach and T. A. Dobretzova. (In Russian, with summary in English.) (*Trans. Transcauc. Cotton Sci. Res. Inst.*, No. 34. Tiflis, 1933. Price 2 rub. Abstr. from *Rev. App. Ent.*, xxii., Ser. A., 2, 1934, p. 56.) An account is given of the results of observations carried out in 1929-30 near Gandzha in Azerbaijan on the bionomics of Aphids, which are among the principal pests of cotton in Transcaucasia. The species concerned are *Doralis* (*Aphis*) *gossypii*, Glov. (of which three varieties are recognised), *D.* (*A.*) *flava*, Nevs., *D.* (*A.*) *laburni*, Kalt., *Myzus persicæ*, Sulz., and *Trifidaphis phaseoli*, Pass., all of which are described from the literature. Their synonymy is briefly discussed, and it is suggested that *D. flava* is only a form of *D. gossypii*. The number of Aphids increased from mid-May till July and then gradually decreased until September, when they began to rise again, the peak of infestation being reached in early November. In winter and the second half of summer they were reduced to a minimum owing to unfavourable weather conditions. During June and July infested cotton seedlings were deformed and stunted, and in autumn the cotton in the opened bolls was affected. The seasonal occurrence and relative abundance of the different species on cotton and other cultivated crops, as well as the parts of the plants on which they occur, are discussed. Their distribution is aided by wind, which carries wingless as well as winged forms for considerable distances, and to a less extent by water in the irrigation ditches, which carries fallen infested leaves.

D. gossypii was the only species of serious economic importance, being sometimes responsible for a loss of over 20 per cent. of the crop and causing the development of sooty mould. It overwintered on various weeds, on which the survivors bred in the spring, the first two generations being wingless and the winged forms appearing at the end of April. The bulk of these passed to cultivated crops as soon as they became available, concentrating chiefly on cotton. No sexuales or overwintering eggs were found. Large numbers of winged forms appeared in May and October. The aphids matured in from 4 to 21 days and continued to reproduce for from 5 to 46; the average duration of life after this being 4·5 days. The total length of life averaged 33·9 days, with a maximum of about three months in winter; winged aphids lived up to 25 days. The wingless aphids produced an average of 42·6 larvæ, with a maximum of 91, and the winged ones 15-28. In 1929 there were 20-22 generations from mid-April to 1st September. The optimum temperature for development is 16-22° C. (60·8-71·6° F.); temperatures above 25° C. (77° F.), excessive moisture, heavy rains and high winds are unfavourable. The food-plants in Transcaucasia include

ten cultivated plants and over twenty weeds; next to cotton, cucurbits are preferred. Of natural enemies, several species of Coccinellids and Syrphid larvæ are the most common and important; an unidentified Hymenopterous parasite (?*Aphidius* sp.) was very active from about the end of April till July, and from the end of July a number of the aphids were parasitized by *Aphelinus varipes*, Först.

Sprays of soap or tobacco extract are commonly used for control, but are usually ineffective, the highest mortality obtained not exceeding 70-75 per cent., owing to the aphids being sheltered in curled leaves. The use of dusts as applied in the United States and their advantages over sprays are discussed from the literature. In field experiments on a small scale the best results were obtained with a 3 per cent. nicotine dust (7·5 parts nicotine sulphate and 92·5 parts slaked lime); used at the rate of about 25 lb. to the acre at 33·5° C. (92·3° F.) in the absence of wind, it killed on the average 94·5 per cent. and sometimes 100 per cent. Special attention should be devoted to clean cultivation, the destruction of weeds in winter, the removal of severely infested seedlings, and manuring, which by promoting the growth of the plants, increases their resistance to attack. No immune variety of cotton was found, and early or late sowing had no effect on infestation.

Notes are also given on the bionomics of *Myzus persicæ*, *D. laburni* and *T. phaseoli*, all of which are of minor importance as pests of cotton. *M. persicæ* developed chiefly on cruciferous weeds, cotton being only infested slightly and for a short period till about mid-July. No sexual forms or overwintering eggs were ever found, and peach was not attacked, this Aphis like *D. gossypii* being anholocyclic and only occurring on herbaceous plants. *D. laburni* was found on lucerne from the end of March to the end of November, and in small numbers on *Robinia pseudacacia* in June; infestation of cotton did not exceed 3·8 per cent. *T. phaseoli* was sometimes observed on the roots of cotton in early summer, but always disappeared in July.

435. Cotton Flea Ravages and Texas Crop. (*Text. Weekly*, xiii., **320**, 1934, p. 213.) According to the American Cotton Crop Service, the Texas Agricultural Experiment Station is greatly concerned over the cotton flea hopper outlook for 1934. This insect during recent years has become a pest of major importance. A recent bulletin issued by the Experiment Station states that records covering an 8-year period, 1926-33, show that 44 per cent. of the emergence of the cotton flea hoppers has taken place by April 1. The emergence this season has been retarded by the cold March weather, and is only 8 per cent., which means that there is a large proportion left in the weeds waiting to hatch after the cotton comes up, and when this has happened in the past injury to the cotton has been abundant.

436. Un Nouvel Ennemi du Cotonnier en Afrique Equatoriale Française *Helopeltis bergrothi*, Reut. By the late A. P. Moreau. (*Bull.* 14, *Assoc. Cotonn. Colon.*, 1934, p. 48.) An account of the life-history of this hitherto little known pest. Eggs are laid upon parts of the plant that are not too woody or too yellow, and cotton is preferred as a host, though Albizzia and some Compositæ and Gramineæ are also attacked. The young insect goes through three metamorphoses, and it is suggested that increase and decrease of the pest follows a cycle of years. The symptoms of the attack are very like those attributed to *Bacterium malvacearum*. The puncture of the insect produces oily spots which may be as much as 2 cm. long, subsequently deepening and darkening. Disinfection of seed does not ward off attack. The employment of better cultural methods, and the burning of injured plants to destroy the eggs of the pest, are recommended.

437. Locusts in Angola. By J. de B. R. Queiroz. (*Int. Rev. Agr.*, Rome, xxv., 2, 1934, M25.) Maize, wheat, rye, and other cereals, several leguminous plants, vegetables, potatoes, fodder plants, fruit trees, various *Ficus* spp., and eucalyptus were attacked by locusts, which in certain places devoured even the bark of the trees. The chick pea when fruiting was one of the few species not attacked, but before it reached the fruiting stage the plants were attacked. In several places the locusts avoided the leaves of coffee, mango, and sweet potatoes.

438. Argentina: *Informe Sobre Procedimientos para la Destruccion de la Langosta.* By C. A. Lizer y Trelles *et al.* (*Bol. mens. Minist. Agr., Argentina*, 33, 2, Buenos Aires, 1933. Abstr. from *Rev. App. Ent.*, xxii., Ser. A, 2, 1934, p. 49.) This is a survey of the mechanical devices, flame-throwers, and chemical measures available in Argentina for combating locusts (*Schistocerca paranensis*, Burm.). Nearly 25,000 miles of metal barriers are said to be kept in stock by the Government. Very brief notes are given on natural enemies, of which the most important are *Phorbia cilicrura*, Rond., parasitizing the eggs, and *Sarcophaga* spp. attacking the hoppers and adults.

439. Northern Rhodesia: *Locust Control.* (*Crown Colonist*, iv., 28, 1934, p. 139.) A new method of attacking locusts is to be tried in Northern Rhodesia by an Imperial Airways pilot, who will use a three-engined Hercules machine fitted with special spraying apparatus and carrying 300 lb. of sodium arsenite, and will fly along the front of the swarm, spraying into the air a curtain of fine powder. It is expected that the powder will remain in the air long enough to destroy even a lengthy column of locusts.

440. Sudan: *Notes on Some Dipterous Parasites of Schistocerca and Locusta.* By A. H. Wood. (*Bull. Ent. Res.*, 24, 4, 1933, p. 521. Abstr. from *Rev. App. Ent.*, xxii., Ser. A, 2, 1934, p. 76.) Experiments were carried out in the Sudan to test the accuracy of records of *Sarcophaga destructor*, Mall., parasitizing *Schistocerca gregaria*, Försk. Adults were easily kept in captivity, and deposited larvæ on overripe fruits. In the Sudan the larvæ cause considerable damage in winter to melons, tomatoes, and egg plants. The larval stage lasted 5-6 days and the pupal 12-22; under dry conditions, however, there is sometimes a pupal diapause of 2-3 months. Adults were abundant in the field from August to February, presumably being carried over the dry season from February to July in the pupal stage. Females caged with locusts at all stages of development did not deposit larvæ on them. Larvæ dissected from the flies and placed near the wing bases of locusts only succeeded in penetrating them immediately after they had moulted. Infested locusts sickened rapidly and died in 2-3 days, and the fully fed larvæ emerged after 3-4 days. When two larvæ were present, 92 per cent. of the locusts died, whereas when one larva entered, only 16 per cent. died, the survival of the remainder being due to the early death of the larvæ in them. The larvæ did not grow normally till the host had died. Moulting locusts did not attract the flies, but mutilated or wounded ones were definitely attractive, and larvæ were deposited in the wound. It is not probable, however, that this species often attacks locusts in nature.

Of several hundred parasitized locusts collected from the Red Sea coast in the winters of 1931-32 and 1932-33, none contained larvæ of *S. destructor*, but varying percentages were parasitized by *Blæsoxipha lineata*, Fall., and *B. filipjevi*, Rohd., neither of these species having been previously recorded from the Sudan.

B. lineata was abundant in the field from November to February parasitizing *S. gregaria* and *Locusta migratoria* (*migratorioides*, R. and F.). Gravid females caged with last-instar hoppers and immature adults of *Locusta* deposited larvæ on some of them. Only one larva was found in each host. The supply of parasites was

maintained by removing larvæ from gravid females and inserting them under a raised flap of chitin on the pronotum of a locust. There were three larval instars. The pupal period was 8-20 days. The larva fed only on the fat body; if the host died before the larva was full grown, the latter died also. Of the artificially parasitized locusts, 78 per cent. recovered and 38 per cent. of these reproduced. When two larvæ were inserted, the host invariably died, and a small percentage in the field contained more than one larva.

In the laboratory, *B. filipjevi* could only be reared by parasitizing the locusts artificially. The larval stage, comprising 3 instars, lasted about 6 days, and the pupal 14-17. The larvæ fed on the fat body, but if this was exhausted before they were full-grown, they attacked the muscles and other tissues. Up to 11 larvæ were bred from one locust. The death of the host does not interfere with the development of the larvæ, so that it is a more efficient parasite than *B. lineata*. It was reared from *S. gregaria*, *L. m. migratorioides*, and *Anacridium mæstum*, Serv.

Descriptions are given of the larvæ and pupæ and figures of the larvæ and the male genitalia of the three flies.

441. TANGANYIKA: *Red Locusts.* (*Crown Colonist*, May, 1934, p. 235.) "The red locusts are reported to be breeding practically everywhere throughout the territory. Many Government officials have been seconded for work of extermination, whilst the King's African Rifles are carrying out very useful work. One planter reports having experienced flights of this pest over his land for 21 successive days. The problem appears one of almost too vast a magnitude to solve with the very limited funds at the disposal of Government."

442. *Nematospora gossypii*: METABOLISM. By H. W. Buston *et al.* (*Biochem. Jour.*, xxv., 1931, p. 1656, and xxvii., 1933, p. 1859. Abstr. from *J. Text. Inst.*, xxv., **4**, 1934, A208.) (1) The statement of Farries that the organism causing the internal boll rot of cotton requires certain "accessory factors" in its metabolism of nitrogen is confirmed, and crude proteins and extracts of lentils are shown to be fruitful sources of them. One factor appears to be inositol. (2) The growth-promoting accessories are found in association with "bios." (3) The second accessory factor occurs in lentils in combination with a nitrogenous base, and can be readily liberated by hydrolysis and precipitated by phosphotungstic acid. Concentrates have been prepared which promote full growth when present to the extent of 1·2 mg. per 100 c.c. of medium.

[*Cf.* Abstr. **554**, Vol. VII., of this Review.]

443. COTTON ANTHRACNOSE IN THE CENTRAL PROVINCES, INDIA. By J. F. Dastur. (*Ind. J. Agr. Sci.*, iv., **1**, 1934, p. 100.) *Summary.*—A new anthracnose disease of cotton bolls and cotton seedlings is described. This disease is different from the one known in America and some other places, where it is caused by *Glomerella gossypii* (Southw.) Edg. Evidence is produced to show that the epidemic of 1931 was due to high atmospheric humidity in October of that year. The disease is carried in the seed. Microscopic characters of an infected seed are described in detail. Hyphæ are found inside the seed-coat, and it is suggested that they obtain entry through the funicular end. Germination of diseased seeds is found to be poor. Seedlings from infected seeds are liable to be killed by the fungus from the diseased seed. Remedial measures found effective in raising the percentage of healthy seedlings from diseased seed are treating the seed with uspulun, sulphuric acid, or copper carbonate. The fungus is provisionally named *Colletotrichum indicum* Dast.

444. Contribution to the Study of Root Rot of Cotton under Central Asiatic Conditions. By P. G. Estifeyeff. (In Russian.) ("Scient. Res. Inst. for Cotton Growing and for the Cotton Industry," Tashkent, 1930. Abstr. from *Rev. App. Mycol.*, xiii., **2**, 1934, p. 93.) This is a detailed report of the author's preliminary investigation of a damping-off of cotton seedlings, chiefly at the two-leaf stage, which is stated to be very prevalent in certain seasons over the whole of Russian Central Asia. The results disproved Zaprometoff's statement that this condition, which was described by him under the name "root rot," is due to mechanical injury to the collar and stem of the seedlings, followed by invasion by certain saprophytes, or is caused by *Rhizoctonia crocorum* (*Helicobasidium purpureum*), the last-named fungus never having been found in diseased material. The term "root rot" is also misleading, since in by far the greater part of the affected seedlings examined the root system remained healthy, the chief symptom consisting in the development of dry cankers on the collar of the stems, which were more or less completely girdled, the death of the plants being caused by the destruction of the cortical tissues. The lesions were never seen to penetrate the xylem, which showed no discolouration. The term "collar necrosis" is considered to be more descriptive of the condition. Cotton seedlings beyond the two-leaf stage appear to be more resistant to the disease, and a fair proportion of those attacked were observed to recover.

The condition was found to be caused by a number of parasites; the most frequent among which (114 out of 218 cases investigated) was *Moniliopsis aderholdi*, which is very widespread in Central Asia, where it has been recorded on *Hibiscus esculentus*, *H. cannabinus*, *Abutilon avicennæ*, and groundnut. Mites and insects were found to further the attack by this fungus, a full description of which is given, followed by an English diagnosis. Next in frequency of incidence (70 out of 218) were *Fusarium vasinfectum*, *F. buharicum*, and other species of this genus, while an undetermined species of *Verticillium* was found in 16 cases, causing collar cankers of a somewhat lighter colour than those induced by *M. aderholdi*.

445. A Study of Certain *Fusaria*. By A. K. Mitra. (*21st Ann. Mtg. Ind. Sci. Cong., Bombay*, 1934: Sect. Bot., Abstr. **16**, 4-5. From *Plant Breeding Abstracts*, iv., **3**, 1934, p. 171.) The question of suitable culture media for six species of *Fusarium* belonging to three different sections was studied. Saltants differed from their parents in such characters as linear rate of spread, aerial mycelium, colour of the substratum, sporulation, average septation, size of the spores, and abundance of the chlamydospores.

446. Relative Susceptibility of Cotton to Wilt. By G. L. Kottur and S. S. Maralihalli. (*21st Ann. Mtg. Ind. Sci. Cong., Bombay*, 1934: Sect. Agr., Abstr. **29**. From *Plant Breeding Abstracts*, iv., **3**, 1934, p. 180.) Almost all Asiatic cottons are highly susceptible to the wilt fungus *Fusarium vasinfectum*. Some commercial varieties, though susceptible, contain some degree of resistance, and on selection yield resistant strains. Such varieties, too, if grown on wilt-infected soils, show rapid improvement owing to the early elimination of susceptible individuals.

447. Studies in Disease Resistance, with Special Reference to Cotton Wilt. By G. L. Kottur and M. K. Desai. (*21st Ann. Mtg. Ind. Sci. Cong., Bombay*, 1934: Sect. Agr., Abstr. **30**. From *Plant Breeding Abstracts*, iv., **3**, 1934, p. 179.) The behaviour of selections of cotton and jowar (sorghum) resistant to red leaf blight, *Striga* and wilt are described. A considerable difference was found between resistance in the field and under controlled conditions in the greenhouse. Different degrees of resistance are mentioned, and their importance in breeding work emphasized.

448. THE PRESENT STATUS OF PLANT VIRUS RESEARCH. By K. M. Smith. (*Biol. Rev. and Biol. Proc. Cambridge Phil. Soc.*, viii., 2, 1933, p. 136. Abstr. from *Exp. Sta. Rec.*, 70, 2, 1934, p. 193.) This is a review of present knowledge of methods of approach to the plant virus problem—properties and nature of plant viruses, symptomatology of virus-affected plants, methods of virus transmission, attempts at cultivation, movements of virus within the plant, metabolism of virus-affected plants, photography of viruses by ultra-violet light, and recovery, "carrying" power, resistance, and immunity relations in affected plants —and on the differentiation of plant viruses. The potato mosaic group is especially considered. An extensive bibliography of the literature on plant virus diseases is appended.

449. BREEDING FOR IMMUNITY. By L. N. H. Larter. (*J. Jamaica Agr. Soc.*, 37, 1933, p. 447. From *Plant Breeding Abstracts*, iv., 3, 1934, p. 172.) After a brief enumeration of the causes of immunity in its various forms, a concise survey of some of the achievements in breeding for immunity is illustrated by concrete examples from the results obtained with vines, pineapples, potatoes, tobacco, tomatoes, wheat, coffee, cotton, sugar-cane, and citrus.

GENERAL BOTANY, BREEDING, ETC.

450. CARNEGIE INSTITUTION OF WASHINGTON, DEPARTMENT OF GENETICS. (*Ann. Rpt. of Dir. of Dpt. of Genetics*, 1932-33, recently received.) The report begins with a consideration of various theories about the nature of the gene, and goes on to the details of work, in which there is much to interest the cytologist. Some interesting work is being done with Datura, where many types of chromosome distribution and arrangement are known. The plant is being studied with a view to the understanding of the nature and origin of species. Other work is going on in human and in animal genetics.

451. MEMOIRS OF THE COTTON RESEARCH STATION, TRINIDAD. (Pubd. by the Empire Cotton Growing Corporation. Price 2s. 6d., post free.) The sixth number of Series A, Genetics, has recently been issued, and contains the following papers reprinted from the *Journal of Genetics*.

THE GENETICS OF COTTON. Pt. IX.: "Further Experiments on the Inheritance of the Crinkled Dwarf Mutant of *G. barbadense*, L., in Interspecific Crosses and their Bearing on the Fisher Theory of Dominance." By S. C. Harland. Further experiments are described on the mode of inheritance of the crinkled dwarf mutant of *G. barbadense*, Linn., when crossed with normal *G. hirsutum*, Linn. Observations were made on the characters of crinkled when transferred by repeated back-crossing to *G. hirsutum* (T. 9). Selfing of the heterozygotes of the fourth back-cross plants produced normal, intermediate crinkled, and extreme crinkled in a 1 : 2 : 1 ratio, and the results from selfing six back-cross heterozygotes showed that no change had taken place through further back-crossing. The new type of *hirsutum* crinkled was apparently slightly less vigorous and productive than the original *barbadense* mutant, though under good conditions little difference was observable. *Hirsutum* heterozygous for the crinkled factor was shown to have a slight advantage over normal under good conditions, and was not at any considerable disadvantage under bad conditions. Transference of crinkled to two further types of *hirsutum* revealed complete or nearly complete dominance of *hirsutum* to the crinkled type. The bearing of the experiments on Fisher's theory of dominance is discussed, and it is concluded that modification of the theory is necessary. Complete dominance of normal over crinkled exists in two types of *G. hirsutum*, although the crinkled mutant does not occur in that species. It is

concluded that modifiers of dominance are of advantage to the wild type, and are thus selected on their own account.

Cytological Studies in Cotton. Pt. II.: "Two Interspecific Hybrids between Asiatic and New World Cottons." By A. Skovsted. Of two interspecific hybrids between Asiatic and New World cottons studied, one had $2n=39$ and the other $2n=52$. For the latter, the inference is that a diploid egg from Asiatic cotton had functioned. In a study of the somatic chromosomes of New World cotton it has been found that half of the chromosomes are small and the other half larger, the latter being comparable in size to the chromosomes of Asiatic cotton. The small chromosomes of New World cotton are of the same size as those in diploid wild species from North America. Species from the Old World and from Australia are all characterized by the larger size of their chromosomes. In the first meiotic division it was seen that (1) at least 13 univalent chromosomes are present in both hybrids, and (2) the hybrid with 52 chromosomes shows the same chromosome conjugation as in a triploid Asiatic cotton, but with the addition of an extra set of 13 non-homologous chromosomes. The conclusion was drawn that New World cottons are allopolyploid species. It is thought that these probably originated from a cross between two species of *Gossypium*, both with $n=13$, but possessing morphologically dissimilar and non-homologous sets of chromosomes. The inference is that one of the parental species was an Asiatic cotton or a very closely allied type, while the other was probably a New World species characterized by its smaller chromosomes.

452. Memoirs of the Cotton Research, Station, Trinidad. (Pubd. by the Empire Cotton Growing Corporation. Price 2s. 6d., post free.) The seventh number of Series A, Genetics, has recently been issued, and contains the following paper reprinted from the *Journal of Genetics*.

The Genetics of Cotton. Pt. X.: "The Inheritance of Leaf Shape in Asiatic *Gossypiums*." By J. B. Hutchinson. The main differences in leaf shape in Asiatic cottons result from the action of a multiple allelomorph series of five numbers, L^B, L^I, L^L, L and *l*. Of these, L^B and *l* give dominant and recessive broad respectively. L^I gives dominant intermediate broad. L^L gives laciniated, and L narrow leaf. L^L, L and *l* give intermediate heterozygotes. L^B and L^I are dominant over all other members of the series. L^L, L and *l* occur in nature in *G. arboreum* and its varieties. L^B and L^I arose by mutation in cultures of a laciniated *arboreum* strain. All *G. herbaceum* varieties so far reported carry *l*. The differences in leaf shape of taxonomic value are differences in minor genes affecting such characters as lobe shape, leaf size, and rumpling, and not laciniation. The leaf shape multiple allelomorph series is linked with a gene for brown lint (K), with about 30 per cent. crossing-over. The Burma Laciniated strain is mutable at the L locus and at the K locus. L^L mutated to L^B, L^I and *l*. Mutation occurred in about 1 per 1,000 of L^L gametes, in about 1 per cent. of homozygous L^L plants, and in 1 in 450 plants of Burma Laciniated $\times 1304$ F_1. K mutated to *k* in about 1 in 500 gametes. L^I mutated to L^B, and L^B mutated to *l*. In one case mutation from L^B to *l* was accompanied by mutation from K to *k*. *Cernuum* is mutable in the L gene. Mutation was observed from L to *l*, and evidence is presented to show that mutation probably occurred from L^L to L. No dominant mutants were obtained from *cernuum*. Mutation occurred from L to *l* in two *arboreum* types, Cawnpore White and A13, in heterozygotes with Mutant Broad. No mutation has been discovered in recessive broad. Mosaics and chimæras of two different leaf-shape genotypes were observed in several crosses. Mosaics were very unstable, and changed rapidly by further mutation to homogeneous mutant types. F_1 hybrids of *G. Stocksii* by four of the five leaf-shape allelomorphs had leaf indices of the same order

as in cultivated Asiatic types. Linkage exists between the leaf-shape allelomorph series and genes affecting lint length, seed weight and lint percentage. The L series and the corolla colour (Y) series assort freely. There appeared to be linkage between the L series and the anthocyanin (R) series in a single cross. In other crosses the two allelomorph series assorted freely.

453. WHAT IS A GENE? By M. Demerec. (*J. Hered.*, **24**, 1933, p. 369. From *Plant Breeding Abstracts*, iv., **3**, 1934, p. 188.) The evidence is outlined upon which, as a working hypothesis, the gene is regarded as an ultra-microscopic organic particle resembling in its structure a single complex organic molecule, though a multi-molecular structure would not invalidate the main theory. The location and linear arrangement of genes and the relative nature of the stability of genes are discussed.

454. THE SIGNIFICANCE OF GENETICS IN EVOLUTION. By C. C. Hurst. (*Gdnrs'. Chron.*, **94**, 1933, p. 291. From *Plant Breeding Abstracts*, iv., **3**, 1934, p. 169.)

455. VERERBUNG (INHERITANCE). By F. Oehlkers. (*Fortschr. Bot.*, **2**, 1933, p. 259. From *Plant Breeding Abstracts*, iv., **3**, 1934, p. 187.) A general summary of the work accomplished during 1932 on tetra analysis, linkage, and the rôle of the plasma in inheritance.

456. HOW NEW PLANTS ARE BROUGHT ABOUT. By F. W. Sansome. (*J. R. Hort. Soc.*, **58**, 1933, p. 314. From *Plant Breeding Abstracts*, iv., **3**, 1934, p. 169.) A semi-popular account of the main genetic principles underlying plant breeding. The phenomena of mutation, hybridization and chromosome changes such as polyploidy as sources of variation are discussed.

457. A METHOD OF PLANT IMPROVEMENT BASED ON THE USE OF HIDDEN HERITABLE BUD VARIATIONS AND THOSE PRODUCÈD THROUGH INJURY. By N. B. Mendiola. (*Philipp. Agr.*, **22**, 1933, p. 465. From *Plant Breeding Abstracts*, iv., **3**, 1934, p. 190.) It is well known that the development of buds may be stimulated by injury, and it is pointed out that the majority of the plants in which bud sports have been recorded are propagated vegetatively. It is therefore argued that by increasing the methods of vegetative propagation, both in range and degree, latent variations may be brought to light which may prove to be of practical value. A bibliography of six pages is appended.

458. FORTSCHRITTE DER CYTOLOGIE IN DER AUSTAUSCH- UND KONJUGATIONSFRAGE (SAMMELREFERAT). By H. Propach. (*Züchter*, **5**, 1933, p. 249. From *Plant Breeding Abstracts*, iv., **3**, 1934, p. 192.) A critical discussion dealing mainly with Darlington's views on crossing-over and conjugation as presented in *Recent Advances in Cytology*. The work of American investigators is also considered in passing.

The author awaits a demonstration of Darlington's theory by genetic experiment and suggests that as experimental material some organism with very strictly localized chiasmata should be used, so that it could be shown that chiasma formation and genetic crossing-over actually coincide. Another method of solving this problem would be the exact analysis of chiasma formation of heteromorphous gemini, differing in as large a number of characters as possible.

[*Cf.* Abstr. **117**, Vol. X., of this REVIEW.]

459. THE INHERITANCE OF "LINTLESS" IN ASIATIC COTTONS. By M. Afzal and J. B. Hutchinson. (*Ind. J. Agr. Sci.*, iii., **6**, 1933, p. 1124.) The inheritance of "Lintless" in Asiatic cottons is described. Three lintless plants have been described in detail. The hairy lintless was discovered in a field of Mollisoni cotton near Renala in Montgomery district. It was indistinguishable from other

Mollisoni plants in all characters, but was absolutely devoid of lint. The other plant was discovered in a field of Mollisoni cotton near Sangla in Sheikhupura district. This plant was absolutely glabrous and the seed had neither lint nor fuzz except for a few hairs either scattered over the seed surface or in a small tuft near the chalazal end. The third lintless plant was discovered by Kottur in Dharwar.

The hairy lintless was found to be a simple heterozygote carrying a lethal factor which inhibited the production of pure-breeding hairy lintless plants. The glabrous lintless plants, however, bred true. The investigations were carried out up to the F_3 generation, and the results are interpreted as resulting from the action of two genes: H^L lethal in the homozygous condition and giving rise to hairy lintless type which is rather weak when heterozygous; h^G, recessive to normal and giving a completely glabrous plant with only a few short hairs on the seed.

460. Inheritance of Pollen Colour in Asiatic Cottons. By V. R. Iyer and R. Balasubrahmanyan. (*Ind. Jour. Agr. Sci.*, iii., **6**, 1933, p. 1116). Very little work has been recorded with regard to the inheritance of pollen colour in Asiatic cottons. As their chromosomal composition is different from the American group, intervarietal and interspecific crosses between *G. herbaceum*, *G. obtusifolium*, and *G. indicum* were effected, and their progenies were studied. The results show that the segregations are in a clear-cut 3 : 1 ratio, indicating thereby that only one pair of factors is involved, and that modifying factors, if any, are in a homozygous condition unlike in the American cottons. The grading of the pollen was done according to Harland's grouping, and it was found that almost all the cottons examined belonged to 2·5 grade except *G. sanguineum*, which was of 3·0 grade. A single plant selection from Coconadas showed zero grade, and this was used as one of the parents. Quantity of pollen, time of dehiscence of anthers, and the presence of sterile anthers influence considerably the correct grading of pollen.

461. Varietal Differences in Cotton Boll Shedding as Correlated with Osmotic Pressure of Expressed Tissue Fluids. By R. S. Hawkins *et al.* (*J. Agr. Res.*, 48, **2**, 1934, p. 149.) The shedding of young Acala cotton bolls was definitely correlated with the osmotic pressures of the expressed tissue fluids of the leaves and day-old bolls. The daily changes in boll shedding and osmotic pressures show no correlation in the Pima variety. The extremely low shedding coupled with comparatively high osmotic pressures may account for the lack of correlation. The spread between the osmotic pressures in the leaves and in the bolls does not seem to be correlated with shedding. The superimposed shedding curves of four varieties differing widely in shedding behaviour show a reverse arrangement as compared with the superimposed curves showing osmotic pressures in the bolls, which indicates a good negative correlation between shedding and osmotic pressure in the bolls. Boll shedding is somewhat more closely correlated with osmotic pressure in the bolls than with osmotic pressure in the leaves.

462. Photoperiodism. By N. N. Konstantinov. (*New Methods of Cotton Culture*, pubd. by NIHI, Moskow and Tashkent, 1933. From *Plant Breeding Abstracts*, iv., **3**, 1934, p. 225.) Many of the perennial cottons are of great value on account of their boll size, disease resistance, etc. By growing them under conditions of reduced illumination, 8-9 hours daily, their flowering and maturity can be accelerated by several months, and they can be crossed with the annual forms. Crosses have been made in this way with the Egyptian cottons to increase the boll size of the latter, which has hitherto been impossible, no large-bolled Egyptians being known. Peruvian and Colombian perennial cottons nearly allied to the Egyptians and having bolls weighing 6-7 gm. have been used in this way, and the hybrids are now in the third generation. Experiment has

shown that the reduction in length of day need be applied only in the early period of development for about 1½ months in the case of perennial cottons, and even less for earlier varieties. This makes it possible to treat large numbers of seedlings which are later transplanted into the field. The onset of sympodial branching and flowering can be similarly accelerated in Egyptian cottons and others. Complete darkness is not essential, the effect can also be produced by periods of "twilight."

463. VERNALIZATION. (*Trop. Agriculture*, xi., **1**, 1934, p. 3.) A good account of the process and underlying principles which should be of interest to many agriculturists. The original papers on vernalization are in Russian, but a review of the principles underlying the process was published by A. A. Sapelin in 1932 in *Der Züchter*. The Imperial Bureau of Plant Genetics has recently issued a summarized account of the experimental work in English, and both these sources have been freely used in the note.

464. JAROVIZATIA: O METODA DE ACCELERARE A VEGETATIEI. By A. Piescu. (*Viata Agric.*, **24**, 1933, p. 349. From *Plant Breeding Abstracts*, iv., **3**, 1934, p. 194.) A brief exposition of Lyssenko's work on vernalization.

465. VERNALIZATION OF COTTON SEEDS BY T. D. LYSSENKO'S METHOD. By V. Stet. (*New Methods of Cotton Culture*, pubd. by NIHI, Moskow and Tashkent, 1933, p. 88. From *Plant Breeding Abstracts*, iv., **3**, 1934, p. 224.) Experiments were conducted by the method recommended by the Ukrainian Breeding Institute,* the air temperature, however, being 3-5° C. higher than that recommended (15-17° C.) and the soil temperature also being slightly too high. Navrotskii and Ashmouni cottons were used, both experimental and control seeds being previously soaked for 1 to 2 days. Sowing was carried out on May 5. On May 18, observations were made on the seedlings, which showed that the vernalized plants were more vigorous, strong and healthy than the controls, being fresher, larger, and denser, in the case of the Navrotskii cotton, but in Ashmouni little difference between the two was detectable. The speed of germination was greater in the treated plants, and the percentage germination was also higher.

FIBRE, YARN, SPINNING, WEAVING, ETC.

466. THE INFLUENCE OF FIBRE-LENGTH ON THE PROPORTION OF FIBRE-STRENGTH UTILISED IN COTTON YARN. By S. Köhler. (*J. of Text. Inst.*, xxv., **4**, 1934, T141.) Part I. deals with the question of the influence of the fibre-length on the number of fibres that break at the breakage of the yarn if other conditions are equal. Part II. deals with the examinations carried out in order to estimate, under certain assumptions, how the fibre-length influences the fibre-strength utilised in the yarn.

467. TEXTILE FIBRES: MICROSCOPY. By E. R. Schwarz. (*Amer. Dyest. Rep.*, xxiii., **61**, 1934. Abstr. from *Summ. of Curr. Lit.*, xiv., **8**, 1934, p. 215.) Recent advantages in textile microscopy, including the preparation of stereoscopic photo-micrographs, the application of motion picture technique and the development of improved systems of illumination, are briefly discussed.

468. SINGLE FIBRE STRENGTH TESTER. By H. B. Gordon. (*Melliand Text. Monthly*, **5**, 1933, p. 244. Abstr. from *Summ. of Curr. Lit.*, xiv., **2**, 1934, p. 31.) The testing machine is made from an old analytical balance of low sensitiveness. The fibre is fastened between two screw clamps, the upper of which is suspended from the stirrup on which the left balance pan hangs. The lower clamp is

* Method not described.

attached to a standard fixed to the floor of the balance case, and provided with adjustments by which the lower clamp can be brought directly under the upper one and raised or lowered as desired. The load is applied to the right end of the beam of the balance by means similar to that used on the well-known "Chainomatic" balances. A watch chain weighing about 20 grams is used; this permits an adjustment of weight of about 10 grams. The effect of the chain in its various positions is determined by the use of weights placed on the left pan. In carrying out a determination the lower clamp is lowered by the screw adjustment until further lowering would move the pointer of the balance from its zero position. The fibre is not twisted by this process as the jaws of the lower clamp are so constructed that they rotate freely in a horizontal plane. Tension is then applied by means of the chain until the fibre breaks. The breaking load is read from the position of the chain. If the fibre has stretched enough to move the balance pointer appreciably from its zero position a corresponding correction is added to the breaking load. The change in position of the pointer gives a rough measure of the stretch of the fibre.

469. Fine Cotton Yarn: Improving Efficiency of Spinning. By A. Beck. (*Spinn. u. Web.*, li., Nos. 48 and 50, 1933. Abstr. from *J. Text. Inst.*, xxv., **3**, 1934, A120.) Practical suggestions are made for increasing the efficiency of the fine cotton spinning process at all stages from the selection and mixing of the raw cotton to the actual spinning operation.

470. Opening and Spinning Machines: Production. By R. Grandeury. (*Fils et Tissus*, **21**, 1933, pp. 535 and 579. Abstr. from *Summ. of Curr. Lit.*, xiv., **3**, 1934, p. 46.) A method of determining the production of openers, scutchers, drawing, speed and ring spinning frames by means of recording counters attached to appropriate delivery rollers is explained, and tables and graphs for rapid calculations are given. The determination of the most suitable arrangement of the machines and the numbers required is discussed.

471. Fabrics: Analysis. By R. Edgar. (*Iowa State Coll. J. Sci.*, **8**, 1933, p. 17. Abstr. from *Summ. of Curr. Lit.*, xiv., **4**, 1934, p. 93.) The results of a study of 300 fabrics are given. The data include details of the nature and length of the constituent fibres, twists and counts of the yarns, and the weight, thickness, width, nature of weave and finish, water extract, ash, shrinkage, breaking load and extension at break of the fabrics. The methods of testing are outlined.

472. Textile Fabrics: Durability. (1) W. Müller. (2) Serivalor Laboratory. (*Textilber*, **14**, 1933, p. 585. Abstr. from *Summ. Curr. Lit.*, xiv., **4**, 1934, p. 93.) (1) A criticism of the work published by the Serivalor Laboratory. The author points out that cloth structure and methods of finishing influence the durability of textiles, and gives the results of some tests on linen fabrics. (2) A reply to the above.

[*Cf.* Abstr. **632**, Vol. IX., of this Review.]

473. Un Nuovo Apparecchio per Determinare la Resistenza dei Tessuti all'uso. By G. Cesconi. (*Boll. della Coton.*, Milan, December, 1933, p. 157.) Describes a new apparatus for testing the strength and durability of textiles.

474. The Power Problem in Cotton Mills. By F. B. Holt. (*Text. Weekly*, xiii., **317** and subsequent numbers.) Discusses steam and electrical installations.

475. Textile Mill Management: Some Psychological Aspects. By H. Richmond. (*Text. Weekly*, xiii., **319**, 1934, p. 182.) A discussion of the qualities that make for successful leadership.

476. Textile Testing Apparatus. By L. Gut. (*Leip. Monats. Text. Ind.*, 48, 1933. *Fachheft, III.*, p. 71. Abstr. from *Summ. of Curr. Lit.*, xiv., 2, 1934, p. 31. Schopper devices for the determination of the staple length and fineness of fibres, for the control of humidity, the determination of the twist of yarns, etc., are briefly described.

477. The Influence of Warp Twist on End Breakage during Weaving. By W. E. Morton and A. Pollard. (*J. Text. Inst.*, xxv., 2, 1934, T60.) The object of the experiment described in the paper was to find out to what extent deviating from normal practice in the matter of warp twist would affect end breakage rate, and consequently weaving efficiency, in automatic weaving. The results obtained showed that: (1) Increasing the twist in the warp yarn up to a twist constant of 5·0 brought about a considerable reduction in the number of end-breakages, in spite of the fact that the yarn strength as measured by the test was thereby reduced. Therefore (2) lea strength cannot be regarded as a satisfactory criterion of weavability. (3) The extension at break was increased to a small, but nevertheless important, extent. In consequence, the decrease in end-breakage may be attributed at least in part to (*a*) decreased warp tension during shedding, and (*b*) less abrasion in the heald-eyes. (4) Another factor which in all probability affected the end-breakage results to a considerable extent was the tendency of increased twist to eliminate weaknesses due to local conditions of soft twist.

478. Studies of Stability of Colour in Raw Cotton. By D. Nickerson and L. D. Milstead. (*U.S. Dpt. Agr., Bur. Agr. Econ.*, 1933. Abstr. from *Exp. Sta. Rec.*, 70, 2, 1934, p. 285.) A series of seven cottons from different parts of the Cotton Belt was examined in co-operation with the Texas Experiment Station and with the assistance of the South Carolina and Mississippi Experiment Stations, to determine the kind and amount of colour change in cotton and the extent to which other factors are related to these changes.

The colour and grade were lowered as the cotton remained open and exposed in the field. Upland cottons at time of opening were fairly constant in brightness, although varying greatly in creaminess or chroma. The creamier cottons held their brightness better than the white cottons, and usually there seemed to be a high correlation between amount of rainfall and change in brightness. Data regarding colour differences, shown by cottons opening early and late in the season, were considered an inadequate basis for conclusions on the effect of time of opening. The colour of cottons opening at or after a killing frost is compared with that of other cottons.

Length and strength tests revealed no definite trend of change with time of exposure, although a relation seemed to exist between the long cottons and the strong ones. The cottons opening after frost were longer than others of the same series, and they were also stronger than cottons picked late in the season from the same field. The percentage of moisture regain gave no evidence of regularity of change in ability to absorb moisture within any single series, nor was any real difference apparent among the series of samples. Cotton kept at room temperature changed very little in colour in ten or even in twenty weeks, although original brightness and creaminess decreased slightly.

Cottons kept at about 133° F. for three months gained creaminess, with seed cottons and lint cottons differing little in result. Cotton heated in the seed did not average quite so much colour gain as did the cottons removed from the seed before heating. Cottons heated at 230° for several days showed a still greater increase in amount of yellow colour. The white cottons seemed to gain more colour than those that were originally creamy.

479. Damp Cotton Yarn: Staining by Bacteria. By A. Brussoff. (*Textilber.*, 14, 1933, p. 596. Abstr. from *J. Text. Inst.*, xxv., 3, 1934, A142.) The develop-

ment of yellow stains on samples of cotton yarn on storing in a humid atmosphere is described. Bacteria were isolated from the affected areas and gelatin cultures were prepared. Yellow stains appeared on fresh samples of yarn on storing in moist air after being inoculated with the cultures.

TRADE, CO-OPERATION, ETC.

480. A PROGRAMME FOR COTTON. (*Text. Weekly*, xii., Nos. 319 and 322, 1934). Part I. deals with the problems of the industry during the past decade, and Part II. with the effect of the shortage of liquid capital.

481. LANCASHIRE COTTON INDUSTRY: TREND OF BUSINESS IN 1933. (*Text. Weekly*, **12**, 1934, pp. 561, 564, and 581.) Extracts are given from the annual reports of the various trade sections of the Manchester Chamber of Commerce.

482. COTTON TRADE INDEX, 1933. By W. H. Slater. (*Text. Weekly*, **12**, 1934, p. 547. Abstr. from *Summ. Curr. Lit.*, xiv., **4**, 1934, p. 107.) "Index numbers" and "dispersions" from the "all cotton" and "all commodities" figures are tabulated for the past ten years or so, 1913 being the reference year (=100). Attention is called to the general price stability achieved in 1933.

483. USES FOR COTTON: SELECTED REFERENCES IN THE ENGLISH LANGUAGE. Compiled by M. C. Benton. (*U.S. Dept. Agr., Bur. Agr. Econ. Bibliog.*, **44**, 1932. Abstr. from *Exp. Sta. Rec.*, 69, **4**, 1933, p. 620.) This bibliography lists 266 references to books, pamphlets, and periodical articles, largely between 1910 and November, 1932, which show the variety of uses for cotton. An index and a list of agricultural economic bibliographies are appended.

484. COTTON HEDGING. By A. H. Garside. (*Text. Weekly*, xiii., Nos. 318-9, 1934, pp. 147 and 184.) Illustrates how cotton merchants, spinners, and manufacturers use Cotton Futures for price insurance.

485. A HUNDRED YEARS OF TEXTILES. This interesting supplement to the *Man. Guar. Coml.* of May 5 contains, among other papers, the following: "Will History Repeat Itself?" (Sir Francis Joseph), dealing with the troubles and triumphs of the nineteenth century: "Lancashire in Prosperity and Adversity," discussing the expansion and set-backs of the industry from the seventeenth century. The supplement also contains brief histories of some of the principal firms connected with the cotton industry.

486. THE COTTON FAMINE IN LANCASHIRE. By W. O. Henderson. (Reprinted from *Trans. of the Hist. Soc. of Lancs. and Cheshire*, Vol. 84, 1933.) THE LANCASHIRE COTTON FAMINE, 1861-1865. By W. O. Henderson. (Man. Univ. Press, 1934. 8s. 6d. net.) These two papers set out the well-known story of the cotton famine during the American Civil War, but the author has succeeded in throwing new light upon it in an historical sense. Dr. Henderson thinks that the crisis was partly due to over-production before the actual war, and partly to the operations of speculators at that time. On the other hand, the crisis brought about important improvements in the industry, and actively stimulated the search for new sources of supply, and in that way it did good even though for economic reasons many sources could not hold their own when America once more began to compete upon the market.

487. COTTON CONTROL BOARD: FUNCTIONS. United Textile Factory Workers' Assen. (*Text. Weekly*, **12**, 1933, p. 415. Abstr. from *J. Text. Inst.*, xxv., **2**, 1934, A103.) The functions of the Cotton Control Board suggested by the Trades Union Congress include the issuing of licenses to approved firms in the cotton industry, the formulation and enforcement of reorganization schemes, and the safeguarding of standards of labour. These functions are briefly discussed.

488. FIRE-PROOF CANVAS. (*Int. Cott. Bull.*, xii., **46**, 1934, p. 227.) A new fire-resistant treatment for canvas promises increased life in service for this cotton fabric in marine service, according to the New Uses Section of the Cotton Textile Institute, New York. Canvas thus treated is said to be particularly adapted for use as covering for life-boats, life-rafts, and other surfaces exposed to the peril of fire. Another use for the fireproofed canvas is as a reinforced outer covering for asbestos-sheathed steam lines. The reinforcement is said to add considerably to the life of the asbestos sheathing.

489. A COTTON HOUSE IN U.S.A. (*Int. Cott. Bull.*, xii., **47**, 1934, p. 389.) Describes a demonstration house in which some 300 square yards of cotton duck will be used for covering the roof, and outside and inside walls.

MISCELLANEOUS.

490. IMPERIAL COLLEGE OF TROPICAL AGRICULTURE. The Principal's Report for 1932-33 shows that the work of the College in all departments proceeded smoothly and satisfactorily throughout the academic year. Long-range research, as in the past few years, centred round four main crops of economic importance—viz., sugar-cane, cacao, bananas, and citrus—and the work on these crops is described. The total number of students in residence was 51, as compared with 45 in 1931-32. 41 scientific papers were published during the year, in addition to articles written for *Tropical Agriculture.*

In the covering note of the Governing Body to the Report mention is made that on January 1st, 1934, His Majesty the King, who is Patron of the College, was graciously pleased to confer on Mr. Geoffrey Evans, the Principal, the honour of Knight Bachelor. The Governing Body regard this, and the honour of C.B.E. conferred on Professor Henry Ballou in June, 1933, then Commissioner for Agriculture, as well-merited recognition of the services of these officers to tropical agriculture.

491. COTTON INDUSTRY RESEARCH: ORGANISATION. By Sir Kenneth Lee. (*Nature*, 132, 1934, p. 216. Abstr. from *Summ. of Curr. Lit.*, xiv., **6**, 1934, p. 170.) A case is made out for planning research with a definite objective, and as an illustration an outline is given of the work that led in the author's firm to the invention of uncrushable fabrics.

492. MEDICAL INVESTIGATIONS IN THE COTTON INDUSTRY. By — Koelsch. (*Zent. f. Gewerbehyg. u. Unfallverhutung.*, **20**, 1933, p. 148. Abstr. from *J. Text. Inst.*, xxv., **3**, 1934, A160.) Deals with the effect of dust in cotton mills. 75 workers were examined. In the combined clinical and X-ray examination nothing abnormal was found in 45 of the 75 workers. Clinical signs of bronchitis and some difficulty of breathing were found in 15 persons, but in none of these was anything abnormal discovered on X-ray examination. They were not characteristic and not of pathological importance from the point of view of the occupation. No case of pneumomycosis or any definite signs of pneumoconiosis were found. Mill fever, which occurs in workers on resuming work after a break, was found in only two cases. About two-thirds of the workers were between 20 and 40 years, and 87 per cent. had worked more than ten years in the industry. Only those workers were examined who were exposed to the dust hazard—*e.g.*, those who dealt with the raw material. Dust counts were made in the work-places of a well-arranged mill; with the Owen apparatus from 70 to 90 particles per c.c. of air were found, of which about two-thirds were smaller than 5μ, and with the Zeiss apparatus from 12 to 36 particles per c.c. of air, of which also about two-

thirds were smaller than 5μ. Owing to the length of the threads of cotton, they seldom enter the alveoli of the lungs and remain in the upper air passages. No signs of silicosis were found.

ADDENDA.

493. SOUTHERN RHODESIA. *Cotton Cultivation* 1932-33. (*Rpt. of Secy. Dpt. of Agr.*, 1933.) Owing to the fact that the payout for the previous crop coincided with the planting season, and the prices received were so unattractive, a decreased area was planted to cotton in 1932-33. The Co-operative Ginnery at Bindura and the Central Cotton Ginnery, Salisbury, continued to function. The former reduced ginning charges by ½d. per lb. and this, coupled with slightly improved prices, is expected to lead to a larger acreage being planted in the 1933-34 season. The question of the advisability of encouraging natives to grow cotton was discussed during the year, and it was decided to institute some demonstration plots in selected areas under the supervision of native demonstrators.

Mr. G. S. Cameron, the Corporation's Cotton Specialist, records that there was severe loss through shedding of buds, flowers and bolls, but it was difficult to judge how much of this loss was due to bollworm and how much to the adverse weather conditions experienced. The effect of jassid was not very noticeable, owing to the resistant qualities of the U. 4 cottons, but this pest would materially have damaged any of the older, susceptible varieties which used to be grown in the Colony. At the Gatooma Cotton Station the season was such that strain, spacing, and other trials were of little value, but difficult seasons serve a useful purpose in enabling suitable and unsuitable strains to be sorted out. A fair number were rejected, leaving three in the big bulk stage—Gatooma 5 (U. 4/64), Gatooma 5/11 (U. 4/64/7/10) and Gatooma 5/21 (U. 4/64/V.). Seven other lots remain for further observation, testing, and multiplication.

494. NIGERIA. *Cotton Cultivation* 1933-34. (*Half-yearly Rpt. of Dpt. of Agr. to March* 31*st*, 1934.) *Northern Provinces.*—The amount of seed distributed was 2,203 tons, as against 1,674 tons in 1932-33. The yield per acre was low, and notwithstanding the exceptionally heavy planting, the crop purchased was almost exactly the same as in the previous year—*i.e.*, 22,000 bales. In a wet year such as 1933 the soil becomes waterlogged by mid-August, and the cotton plants, which are very susceptible to "drowning," can make no further growth till the soil dries out in late September. The prices paid were higher than at any time since 1929, and were very satisfactory to the grower; they ranged from 0·9d. to 1·1d. per lb. Ginning percentages were high—30 per cent. at Funtua and 29 per cent. at Gusau. There was a marked absence of stained cotton, but the proportion of immature cotton was greater than usual. Arrangements have been made for the distribution of nearly 4,000 tons of seed for the 1934-35 season. The demand is extremely keen, and with a good growing season it is probable that the crop will exceed the previous largest crop, which was 37,356 bales in 1925-26.

Southern Provinces.—Falling prices in recent years have led to a decrease in the number of bales of Ishan cotton exported. From 6,000 bales in 1929-30 the export fell to 860 bales in 1932-33. Farmers, however, appear to have become reconciled to the lower prices, and last season planted a much larger acreage than in the previous year. It is anticipated that the total purchases this season will amount to some 3,000 bales. The grading of the crop showed a further falling off, farmers being unwilling to pick over their cotton in order to bring it up to a higher grade, and preferring to accept a lower price for a lower grade.

495. Memoirs of the Cotton Research Station, Trinidad. (Pubd. by the Empire Cotton Growing Corporation. Price 2s. 6d. post free.) The sixth number of Series B. Physiology has recently been issued, and contains the following paper reprinted from the *Annals of Botany*:

Studies on the Transport of Nitrogenous Substances in the Cotton Plant. Part VI.—Concerning Storage in the Bark. By T. G. Mason and E. Phillis. Curtailment of nitrogen supply to the roots limits the development of the young tissues and organs at the apex. Nitrogen travels from the mature leaves and petioles upwards to the young leaves and the stem. It also travels to the bark and wood of the older parts of the stem, which increase their concentration of nitrogen. As there is no withdrawal of nitrogen from the bark, even though nitrogen starvation is limiting the development of the tissues and organs at the apex, there is no suggestion that the negative gradient in the bark contains a storage component.

As flowering proceeds and bolls develop, nitrogen is withdrawn from the vegetative parts of the plant. For the bark this loss is relatively greater from the lower than it is from the upper region of the stem. Coincident with this withdrawal there is a change in the direction of the concentration gradients. At the beginning of the flowering cycle the concentration in the lower region greatly exceeds that in the upper, and the gradient is negative. At the end of the flowering cycle the concentration in the upper region is slightly in excess of that in the lower region, and the gradient becomes positive. From these observations it is inferred that there is a greater proportion of storage nitrogen in the lower regions of the bark than in the upper regions, and that the original negative gradient consists of a steep negative gradient of relatively static storage nitrogen and a less marked positive gradient of translocatory nitrogen.

During bolling there is no withdrawal of calcium from the vegetative plant, nor from any of its tissues or organs, and the concentration gradients in the bark remain negative. It is concluded that calcium is not normally in movement in the phloem.

The nitrogen gradients in the bark remain markedly negative under conditions where nitrogen is limiting vegetative development. They are also markedly negative under conditions where nitrogen supply is in excess of requirement. It is inferred that the storage of nitrogen in the bark is unaffected by supply.

ERRATUM.

On page 116 of the April number, Table II., first column: "Compost added at 14 tons an acre" should in both cases read "at 1·4 tons an acre."

PERSONAL NOTES

OFFICERS ON LEAVE.

When an officer of a colonial Department of Agriculture (or of the allied departments of Irrigation, Transport, etc.) comes "home" on leave, he usually brings with him much information that may be of considerable value to similar officers in other colonies, or to the officers of the Empire Cotton Growing Corporation, who have to collect, collate, and use all possible information relating to cotton. The Corporation would consequently much appreciate the courtesy if Directors of Agriculture and others would be so kind as to inform them, in advance

if possible, of the names, probable addresses, and approximate dates of arrival in England of officers coming on leave. This would give the Corporation the opportunity of getting into touch with these officers themselves, and of giving the latter the opportunity of meeting with one another. A further courtesy would be conferred if the officers themselves, upon arrival, would call at, or inform, the offices of the Empire Cotton Growing Corporation, which are at the corner of Millbank and Wood Street (entrance by the first door in Wood Street), immediately opposite the offices of the Crown Agents for the Colonies.

At the date of writing, the following officers are on leave or will shortly be arriving in England, from cotton-growing countries:

Ceylon	Mr. C. N. E. J. de Mel.
"	Mr. E. J. Livera.
Cyprus	Mr. H. M. Morris.
"	Mr. A. Pitcairn.
Fiji	Mr. H. W. Jack.
"	Mr. H. R. Surridge.
Gambia	Mr. J. Pirie.
Gold Coast	Mr. J. D. Broatch.
"	Mr. G. S. Cotterell.
"	Mr. G. Cowan.
"	Mr. R. J. W. Grimm.
"	Mr. E. L. Hay
"	Mr. E. D. Hill.
"	Mr. W. R. Hudson.
"	Mr. F. R. B. Mullen.
"	Mr. L. J. Packham.
"	Mr. S. T. Phillips.
India	Dr. N. Ahmad.
"	Mr. R. G. Allan.
"	Mr. F. K. Jackson.
"	Mr. D. G. Munro.
"	Mr. W. Roberts.
"	Mr. K. S. Sawhney.
"	Mr. H. R. Stewart.
"	Mr. R. B. B. Viswanath.
Kenya Colony	Mr. G. M. Eames.
"	Mr. R. N. Noble.
"	Mr. C. O Oates.
"	Mr. N. D. Spranger.
"	Mr. W. O. Sunman.
"	Mr. C. A. Thorold.
Nigeria	Mr. W. B. Dowson.
"	Mr. F. D. Golding.
"	Mr. E. W. Leach.
"	Mr. J. P. Maule.
"	Mr. S. D. Ross.
"	Mr. R. J. Sutton.
"	Mr. G. N. K. Turnbull.
"	Mr. O. J. Voelcker.
"	Mr. W. G. Watson.
"	Mr. J. West.
Northern Rhodesia	Mr. C. J. Lewin.
Palestine	Mr. F. J. Tear.

Sierra Leone	Mr. F. J. Martin.
Sudan	Mr. M. A. Bailey.
"	Mr. W. P. L. Cameron.
"	Mr. R. C. Colvin.
"	Mr. H. E. King.
"	Mr. A. R. Lambert.
"	Mr. E. Mackinnon.
"	Mr. G. F. March.
"	Mr. R. E. Massey.
"	Mr. A. P. Thompson.
Tanganyika Territory	Mr. B. D. Burtt.
" "	Mr. T. C. Cairns.
" "	Mr. C. B. Garnett.
" "	Mr. J. G. M. King.
" "	Mr. T. W. Kirkpatrick.
" "	Mr. G. W. Lock.
" "	Mr. C. J. McGregor.
" "	Mr. F. M. Rogers.
" "	Mr. A. S. Stenhouse.
" "	Mr. A. Young.
Uganda	Mr. H. Hargreaves.
"	Mr. C. Hazel.
"	Mr. H. R. Hosking.
"	Mr. W. T. O. Maidment.
"	Mr. E. G. Staples.
West Indies	Dr. H. R. Briton-Jones.
" "	Prof. E. E. Cheesman.
" "	Mr. G. Gianetti.
" "	Mr. F. G. Harcourt.
" "	Mr. G. A. Jones.
" "	Mr. D. D. Paterson.
" "	Mr. P. E. Turner.
" "	Mr. W. Walwyn.

Sir Geoffrey Evans, Principal of the Imperial College of Tropical Agriculture, Trinidad, and Controller of the Corporation's Research Station in that island, is on leave in this country.

The following officers of the Corporation's staff abroad are also on leave, or will shortly be arriving in England:

Nigeria	Mr. A. E. Casement.
Nyasaland	Mr. H. C. Ducker.
Southern Rhodesia	Mr. G. S. Cameron.
South Africa	Mr. F. R. Parnell.
" "	Mr. F. S. Parsons.
" "	Mr. M. F. Rose.
Sudan	Mr. T. Trought.
West Indies	Mr. S. H. Evelyn.
" "	Dr. E. Phillis.
" "	Dr. A. Skovsted.

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THE EMPIRE COTTON GROWING REVIEW

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THE SECOND CONFERENCE OF WORKERS ON COTTON-GROWING PROBLEMS

THIS Conference was held on July 18, 19, and 20, 1934, preceded by a reception given by Sir James Currie on the evening of the 17th in the rooms of the Royal Society. The attendance was too large for the Conference to take place at Millbank, and it was held in the rooms of the Royal Entomological Society in Queen's Gate.

In one way or another, usually by actual delegates, the various cotton-growing parts of the Empire were represented, so that all the different points of view of the many problems considered could be brought before the meetings, and a valuable exchange of opinions was made both there and in private conversation. The first congress, that of 1930, was fruitful in results, and there is good reason to hope that the second will be even more so.

The organization of the Conference was as near perfection as need be desired; some weeks beforehand the actual papers were printed and circulated to those attending. At the meetings they were taken as read, so that the whole time available could be, and was, devoted to discussion under several different chairmen, each of whom was a specialist in the subject that was then under consideration. The time allotted for each group of papers proved to have been remarkably well chosen, and was usually occupied to the full by the discussion that went on.

The first item that came up for consideration was that described in the memorandum that follows. It was brought forward by the Corporation in order that the views of workers in cotton-growing countries might be obtained:

REPORTS FROM EXPERIMENT STATIONS

The Corporation wish to take the exceptional opportunity afforded by this Conference to ascertain the views of workers on cotton-growing problems on the form that the annual Reports received from Experiment Stations should take.

The difficulty encountered is common to reports of all applied research work, and put briefly is this: How are the results of such work to be presented, bearing in mind the dual purpose that they are required to serve? Thus (*a*) they must convey a clear idea of the objects and results of the work to those who probably have little or no technical knowledge of the kind of work described, but to whom the results are of sufficient importance for them to have financed it, and who are therefore entitled to have those results put before them in a form in which they can understand them.

(*b*) They must be directly serviceable to those engaged in similar work in places other than that in which the original experiments were carried out—thus saving time and labour and unnecessary repetition.

The Corporation have now issued their volume of Reports from Experiment Stations annually since 1923. After two years it was clear that the subject matter was both too technical and too detailed for any readers but workers on the same or allied subjects, and the Executive Committee were fortunate in enlisting the services of Dr. Willis to write a preface to the volume, in which the contents of the reports were reviewed in such a way as to bring out for the benefit of the general reader the main lines that the various investigations were following and the principal results obtained. But as the Corporation's work extended, the number of Experiment Stations increased and the volume of reports grew unwieldy. The Research Committee discussed the question, and on their recommendation the several Stations were asked their views on a proposal that each Station should produce a full report every third year only. With twelve Stations, each annual volume would thus contain four full reports. Any Station should be at liberty, however, to include between its full reports an account of any piece of work that was nearing, or had just reached, completion. In the years that intervened between the full reports, each Station should submit only a short general description, in non-technical language as far as possible, of the work of the past season, including also such tables and graphs as might be needed to illustrate the principal results, and to preserve the continuity of such records. All Stations should, further, include in these summarised reports, or in the form of a separate note if desired, any observations or results that might be of immediate use to co-workers.

It was hoped that this scheme, in conjunction with Dr. Willis' general review as preface, would go some way towards producing a volume of reports that would fulfil both the purposes described above. The procedure has, however, only been partially successful; the authors of some of the summarized reports have evidently found a difficulty in producing the " short general description in non-technical language, as far as possible, of the work of the past season "—admittedly no easy matter, even to those who have had long experience.

The question arises, therefore, as to how an improvement can be made, keeping in view the necessity for producing an annual Report that will give a clear and concise, but adequate idea of the progress made and the difficulties encountered, and also for including sufficient detail to enable workers on similar problems to gauge the value of the work and make use of its results, thus expediting progress.

One suggestion that has been made is that (i) the annual Reports from all Stations should consist every year of a general account only of the problems investigated and the results obtained (with the proviso mentioned above, that everything believed to be of immediate help to fellow workers might be included, in such detail as is thought necessary, in the form of a separate note); (ii) the separate pieces of work should be submitted for publication as soon as they were completed, under the names of the respective authors, to the editors of appropriate scientific journals; the Corporation might then purchase reprints and distribute them to other members of their staff, and possibly to workers on similar problems on the staffs of Agricultural Departments in cotton-growing countries where they had no staff of their own.

The Corporation desire to take advantage of this Conference to hear the views of those present on this proposal, and to receive alternative suggestions as to what is the best form for these Reports to take, with a view to (*a*) keeping the cotton industry in touch with the Corporation's experimental work and maintaining their interest, and (*b*) disseminating information that may be useful at other Stations, bearing in mind the finding of the Milner Committee that " Money spent on agricultural investigation and research must, it seems to us, be largely wasted if the results obtained are not fully recorded and made available to all."

The difficulty is the same as that which is always felt in the editing of this journal. It is intended primarily to be of use to

workers in cotton in the cotton-growing parts of the Empire—*i.e.*, chiefly to the actual growers of the cotton (when they happen to understand English), to administrators in cotton countries, to breeders, and to those who are concerned with the prevention and cure of pests and diseases—entomologists, mycologists, and others. But it must also be interesting and intelligible to those (chiefly in Europe) who are concerned with the manufacturing industries in which cotton plays so important a part, and in particular to members of the Corporation in Lancashire by whom the work is financed.

A paper written in a fully technical way by a breeder, let us say, will be practically unintelligible to a spinner, while one written by a weaver will be equally unintelligible to a mycologist. One of the chief objects kept in view in the production of the journal being to increase and foster the interest and comprehension of each group of workers in the work of the others, so that each shall more fully understand what the other is doing, and what he can and cannot do, it is clear that how best to conduct such a journal will always be a bit of a problem. Something can be done by insisting upon a minimum use of technical terms, something by avoiding as far as possible papers which are ultra-technical or very long. But great simplification would often mean greatly increased bulk, which is not permissible for yet other reasons, while at the same time many people, when deprived of the use of their familiar technical language, cannot write a clear and easily comprehensible account of the subject that they have in hand. In the case of this journal in particular, the matter is further complicated by the fact that there is no plethora of articles available for any particular issue. The result finally is the actual compromise that may be seen in the various numbers published.

The problem of publication of the Reports of the Experiment Stations is exactly parallel to that which we have just considered. One must publish the reports so as to fulfil their immediate object—the presentation of an account of the work that is going on in such a form that it may be useful to others who are doing similar work and may save them from repetition and from wasted labour—while at the same time fulfilling another object which is of as great importance, that of giving to the man who in regard to such work is a layman a clear understanding of the work that is being done, so that he, who to a very large extent finds the money, may be convinced that he is getting the full value for that money.

Again some compromise is clearly necessary, and the various speakers evidently had this in view. One suggested that the detailed work should be separately published in definitely scientific journals,

but this plan has certain disadvantages. The scientific journal would reduce the detail, the results would be more scattered and less accessible to many workers in tropical stations; and unless abstracts were given in the Report—a proceeding which is sometimes a handicap to the acceptance of papers elsewhere—the non-technical readers of the Report, at any rate, would not realize what was being done with their money.

We are inclined to think that the present plan of publication need be but little modified for the moment. We would begin each report with an *Introduction* and *Summary* in one, and this should be written for the layman and issued separately to the non-technical public, while details of the work should follow, preferably perhaps in slightly smaller print. The Introduction and Summary should be rather longer than is at present the case, somewhat on the lines of those given for the stations at Magut and elsewhere.

The first portion of the work of the Conference was devoted to a consideration of problems in genetics and breeding, which have now, as began to be evident some twenty years ago, risen to a position of major importance in the work of any up-to-date organization that concerns itself with general agriculture. The opening paper, by Mr. A. E. Watkins of Cambridge, on the practical application of genetical science to plant breeding, struck a note that was rather upon the pessimistic side. The two principles, of pure line breeding and of character recombination, were in actual use by breeders before they were rediscovered and fully worked out by science, and their application was thought to have been pushed about as far as it would go. Newer lines of work were needed, and it was pointed out that the formation of polyploids (*cf.* two articles in this Review, Hurst, vol. x., 3, 1933, p. 195, and Gates, vol. xi., 3, 1934, p. 194) was a promising line. But it may be pointed out that larger collections of cotton varieties, more like those possessed by the Russians, will be needed to enable full advantage to be taken of the possibilities in work of this kind.

Other speakers were rather more optimistic, but the general impression that one gathered was that one must not expect too much. History, in fact, is repeating itself. Each great new discovery is hailed, sooner or later, as if it marked the beginning of a millennium. Presently it begins to be found that the millennium is as far away as ever, and the great discovery is fortunate if it is kept in sufficient prominence to be able to do efficiently the work of which it is undoubtedly capable. Each new discovery of importance, like that of

Mendel's law, widens the front of the never-ceasing attack upon the great problems that confront the scientific worker, and often does that in ways that are quite unsuspected.

Dr. Harland followed (by proxy) with a paper on interspecific hybrids and their value. In Turkestan, he said, the great numbers of Egyptian-American hybrids rarely showed one that was as good as either of the parents, and he summed up by saying that though the Russians have great hopes of good results from such work, it is too early as yet to speculate on this until we have a good deal more information upon several points. But it is clear that there are various possibilities open, such as bringing into the cultivated cottons the very xerophytic or drought-resisting characters of some of the wild species. What the Russians appear to have done with the potato, in making it capable of withstanding frost, is a good illustration of the kind of thing that is not impossible in this direction.

In the next paper Dr. Harland dealt with Selection Effects in Pure Lines of Sea Island Cotton selfed for seventeen generations, and showed how selection was still possible. It is clear that cotton has been so mixed in the past that we have usually a very long way to go to get a pure line. Mr. Evelyn instanced Marie Galante cotton, stating that though it had been the cotton of Carriacou since 1831 a very fine new selection had lately been made. He was of opinion—but Mr. Cameron and others thought differently—that breeders were inclined to go too much for an improvement in one character only, or at a time. Professor Haldane, the chairman, thought that the idea of a pure line was used in cotton with too little regard for accuracy. One speaker suggested that it should be called a pedigree line, others that the name should be dropped till we had come somewhat nearer to the ideal, which Dr. Balls considered was not unattainable.

Dr. Skovsted then dealt with cytogenetics, and pointed out that there were possibilities for the production of new types both of Asiatic and of American cottons, to say nothing of the further possibilities offered by hybrids between the two. Mr. Watkins pointed out that resistance to rust has been transferred from the tetraploid (macaroni) wheats to the hexaploid (bread) wheats, and Dr. Skovsted went on to say that some of the wild cottons are very immune to pink boll worm and other pests or diseases. Mr. Jackson called attention to the value of a study of the root system, emphasizing its importance in the question of resistance to disease. Professor Engledow said that no character-transference was simple for which one was paid, and gave the example of the cross macaroni × bread (wheat) which would not sell on account of the yellow tint in the flour.

A paper by Messrs. Trought and King, on a new system of preliminary testing, aroused but little discussion, as did also the next two papers on Cotton-breeding Problems in Northern Nigeria and in Kenya.

On Wednesday afternoon statistical methods and allied subjects came up for consideration. Messrs. Hansford and Jameson described an extension of Brown's Purity Target diagrams, but Dr. Balls pointed out that these were only intended as pictures, and was somewhat sceptical of the value of any extension of the method.

Observations on crop loss and yield were introduced by Mr. Cameron on behalf of the staff in Southern Rhodesia, asking whether, with more than three variables, the latin square should not be used in preference to the randomized block, and pointing out that ordinary plot technique was not always of much use in a country like Rhodesia, where the soil was very variable, and intensive attacks of insects might vitiate the results. The discussion seemed to show about equal argument on both sides.

In the discussion of Mr. Wishart's paper on Analysis of Variance and Co-variance there was an evident feeling that too much elaboration and expense might easily be involved by too much statistical work. Sir Geoffrey Evans pleaded for the devising of experiments for officers in the Agricultural Departments that would not cost too much in either time or money, and Mr. Parnell pointed out that it was easy to lay down experiments, but not always so easy to finish them satisfactorily without some contretemps, such as a heavy rainstorm or an unusually severe insect attack.

A final paper by Mr. Heath dealt with Sampling and Growth Observations on a plan now being tried at Barberton, and considered the practicability of sampling technique as ordinarily practised, and whether it is probable that with present methods we can properly study the effects of different conditions.

The second day, Thursday, July 19, opened with a number of papers dealing with cotton pests, followed by others concerned with diseases. To one who has followed this kind of work for a lifetime —starting with what was apparently the first appointment in the British tropical empire of a professional entomologist, Mr. E. E. Green, recently President of the Royal Entomological Society— the point of interest was to note the steady movement of opinion that is going on in the direction of believing that in a general way the prevalence and undue incidence of pests (and perhaps or probably of diseases also) is bound up with unfavourable climatic and other conditions and with errors of cultivation. Dr. Williams, in

a paper on the Relation of Insect Pests to Climatic Conditions, stated that opinion was veering to the conception that climate was the chief factor in the matter, but in the tropics, at all events, not so much the temperature as its other constituents, the idea that temperature was the chief item arising more or less unconsciously with work in the cooler regions of the world.

We were informed that at Rothamsted a field experiment upon the relation of insects to climate was being carried on upon lines as nearly akin to laboratory conditions as possible. Certain correlations were being discovered. On days of similar maximum temperatures, for example, the insect captures in the light traps varied to a large extent with the minimum temperatures, and so on.

Mr. Thomas thought the subject was of much more practical interest to the grower than some others. The incidence of white-fly in the Punjab was largely determined by (1) climate, and (2) the damage done by rain, by predators, etc. The attacks of jassid come every five or six years, and a man might begin breeding something in the first of these years, and lose it all at the next attack of jassid. Experimental work should take account of all difficulties, and should be prolonged over sufficient time to meet them all before new varieties were distributed for general cultivation.

On behalf of the Punjab Department of Agriculture it was stated that this was a somewhat incomplete representation of matters. It was also instanced that the geographical distribution of the resting stage of pink bollworm depends largely upon climatic conditions, and the subsequent attacks in turn depend largely upon this. Mr. Evelyn pointed out that in St. Vincent losses from pink bollworm were heavy so long as the traditional date of planting (June) was adhered to, but that there was almost no further loss when the date was altered to September.

Sir Geoffrey Evans pointed out that in using biological control methods one must understand the conditions governing the pest before one can make successful introductions, and that the incoming of team work was causing more rapid progress.

On page 8 of Dr. Williams' paper there is a very interesting climatic map for the cotton seasons in many different countries, and it is of special interest to note how the various lines of temperatures come more or less closely together at the beginning of the picking season, though in some places planting goes on with a falling, in others with a rising, temperature.

This paper was followed by one by Mr. Hargreaves of somewhat similar nature. But Mr. Parnell thought that the idea that jassid was

correlated with poor soil and water-supply was not the whole matter. Many plants seem susceptible because the leaves are not hairy enough. A plant often gets jassid when full of crop and beginning to ripen.

Mr. Jackson noted how the discussion was illustrating the value of approach to a problem by different lines. The problem was broadening out, and the specialists were getting less narrow.

In Java an insect attack on sugar was regarded as a sign of bad cultivation. Dr. Balls mentioned a case at Giza where the north side of a field was free of aphis, but not the south, the difference being due to roots meeting unsuitable conditions.

Dr. Williams in his reply stated that pest and plant have each optimum conditions, and if these coincide it is more difficult to control the pest. It is therefore necessary to get previous information about environmental conditions.

In a later paper Mr. Parsons dealt in some detail with the phenological observations on insect pests and their incidence that are going on at Barberton. The trap crop idea was old, but was getting on to a sounder basis. In the past, too much attention had been given to the pest, and too little to the host.

A paper by Messrs. Bebbington and Allan, dealing with the interrelationship of wild host plants and cotton in the case of stainers in Northern Rhodesia, followed, and was received with considerable interest. Northern Rhodesia, it was stated, was never likely to be of serious importance as a cotton centre, but cotton was about the only cash crop available for the natives, maize being overdone. The ecological survey has shown that the European area has many available stainer hosts.

Sir Geoffrey Evans pointed out that in Queensland cotton grew well, as stocky plants that got no bollworm, when sown in the early rains, while the late-sown cotton grew much larger and was attacked by Heliothis.

A paper by Mr. Bedford on the control of pink bollworm in the Sudan followed. No practicable method seems to have been discovered for controlling it in the growing season, and preventive measures appear to be the only hope. *Hibiscus esculentus* seems the only host plant in the off season. Mr. Sampson stated that the pink bollworm only assumed importance in Madras with the incoming of the American types of cotton. Dr. Balls found that infestation by this pest fell off very rapidly from the focus of infection—*i.e.*, places where old cotton sticks were stored—being halved at every 200 metres. The Chairman (Dr. Neave) stated that entomologists were still very ignorant of the ecology of insect pests.

On Thursday afternoon the Conference went on to consider the diseases of cotton, beginning with a paper by Mr. Massey on Angular Leaf Spot and Blackarm. He emphasized the importance of the debris problem in the Sudan, the greatest that we have to face. The Sudan Plantations Syndicate and the Government have been making great efforts, including flooding the debris for four days, a period which is found to render it innocuous. A paper by Mr. Hansford followed, dealing with Blackarm in Uganda. He pointed out the disadvantages of the monopodial cottons at present chiefly grown, and the superiority in this respect of the U4 cottons.

A leaf curl from Fiji submitted (as a picture) was generally considered not to be what is ordinarily known as leaf curl elsewhere.

There was a discussion upon the effects of disease upon quality, and it was agreed to send specimens for examination to the Shirley Institute. Dr. Butler, in summing up, stated that diseases must be separately studied in different countries. The conditions differ, and the disease differs.

Physiology was the next subject to come up for discussion, and an important paper by Mr. Jackson on the health and vigour of the cotton plant in relation to its environment was the first item. The yields of cotton in Central India are low, and appear to be due largely to nutritional deficiency, and this paper gives the results of various observations made. The paper does not lend itself to a brief review, and should be read by all those who are interested. The other paper was by Dr. Gregory, and was a good deal criticized by several people: but it admittedly introduces a new point of view.

Friday, the last day of the Conference, was mainly devoted to spinning problems. The first paper was by Messrs. Peirce and Lord of the Shirley Institute upon Variability in Cotton, with special reference to Immaturity. Variability, to a larger extent than is always realized, is a marked characteristic of nearly all, or all, cottons. It affects the demand, which is less for the most variable cottons, and a great step would be taken in advance could it be largely obviated. There are three practical problems: (1) to reduce the variability of the material, (2) to determine the correlations between the variants, and (3) to find invariants. Hairweight is the character that is worked on more than anything else, yet it is really a complex of two—cell diameter and degree of thickening.

Mr. Hosking stated that the same strain of cotton might vary in staple length between 24 and 36 mm. Dr. Balls pointed out how almost hopeless it was ever to expect uniformity when no two seeds ripened under exactly the same conditions, and pointed out the

desirability of periodic exchanges of duty between members of the staff of the Shirley Institute and members of the staffs of the various stations working with cotton in different parts of the Empire. This suggestion was warmly supported. He also pointed out that a thoroughly matured crop may be too coarse in the fibre, and not so good as one not quite so mature. The Egyptian crop of last year was 10 to 15 per cent. too much thickened in the hair walls.

Miss Clegg's paper dealt with neps and motes. The spinners cannot get rid of these, and the question was whether the growers or the breeders could do so. The general opinion seemed to be that neps were to such an extent—*e.g.*, in the formation of undeveloped ovules, which might be from 1 to 4 for each loculus—an hereditary character that it might be a very difficult, if not impossible, task to get rid of them altogether, though there was little doubt that they could be reduced in number. Four years ago Dr. Harland called attention to lethal factors which killed some of the ovules. We have dealt with this question in the Review of the last conference (vii., 1930, p. 261) and there is little to add to what was then stated.

A further discussion was on the question of various kinds of saw gins and roller gins, and except for the long staple cottons where a roller gin must be used, opinion seemed to be divided, though Miss Clegg said that the saw gin tended slightly to produce more neppiness.

The third paper, by Mr. Underwood, reviewed the Empire cotton-spinning tests that had been carried out. One thing that was suggested in the discussion was that the tests carried out might be roughly proportioned to the productive capacity of the country concerned. Another point that caused a good deal of discussion was the statement that after a test has shown very good characters for a particular cotton, bulk purchases do not give such good results, as indeed one would expect, for the material sent for the test is usually, and naturally, of the best available of that particular kind, and not until some time later is seed as good likely to be distributed for use. Dr. Balls said that the question had been seriously debated whether it would be well artificially to lower the grade of the samples sent in for spinning tests, but it was difficult to devise a technique for doing this in a " natural " manner.

Mr. Sampson was glad to hear that the idea of growing a shorter stapled cotton was becoming more in favour; but Sir William Himbury warned people against its acceptance. It might be all very well for Uppers, but in less valuable kinds of cotton an enormous competition had to be met, and America and India would be found to be most formidable opponents.

There followed a paper by Messrs. Turner and Underwood on Fibre Properties and Spinning Value, which also aroused considerable interest, while much sympathy was expressed for Dr. Turner upon the hitherto not very satisfactory results of the great labour that he has devoted to this subject—a question whose definite solution would have incalculable value.

On the whole, the Conference may be pronounced to have been a conspicuous success, and we may look for valuable results from it. The present time is probably a critical one with regard to the future of Empire cotton. The work of President Roosevelt is showing itself in a rise of price of cotton, and as yet the American share of production for the world market is so great that nothing that can be done by the other countries that grow American cotton will make any serious difference to the rise that is going on. Now, therefore, is the time for those other countries to increase their share in world-production, and already, in fact, a number of them are doing so.

THE COTTON CROPS

BY

JOHN A. TODD.

VARIETY OF SUPPLIES

[The following article (reprinted from *The Times Trade and Eng. Supplement*, British Empire Products Number, May 19, 1934, by kind permission of the Editor) is included, since we think the subject is one which will prove of considerable interest to our readers.—ED.]

IN discussing the cotton industry of the British Empire, whether from the point of view of consumption or production, its position in relation to the cotton industry of the world as a whole must always be borne in mind. This relationship has, of course, three aspects: spindleage, consumption, and crop production. At July 31, 1933, the British Empire possessed 59,747,000, or 39 per cent., of the 153,756,000 spindles in the world, and during the season ending on that date consumed 5,057,000 bales, or 21 per cent., of the world's total consumption of 24,332,000 bales, while during the year 1932-33 the Empire produced altogether 5,025,000 bales, or say 20 per cent., of the world's total crop of about 25 million bales.

Unfortunately none of these figures can be taken at their face value. Spindleage and consumption may roughly represent the volume of a country's cotton industry, but they by no means indicate its true value. Thus of the Empire's total spindleage the United Kingdom had 49,001,000, India 9,506,000, and Canada 1,240,000 spindles. Consumption in the United Kingdom, however, was actually less than in India, with only about one-fifth of the spindles —namely, 2,248,000 bales, against 2,636,000. Thus India consumed 277 bales per thousand spindles, while Canada only consumed 140 and the United Kingdom only 46 bales. The explanation is, of course, first, that Indian bales, like those of the Empire generally, are only 400 lbs., against American 500 lbs., and Egyptian 750 lbs., and as the United Kingdom uses very little Indian cotton, but a large quantity of American and the highest proportion of Egyptian of any country in the world, her consumption in bales is entirely out of proportion to the value of her output of yarn, which is very largely of high counts and fine quality. If it were possible to obtain

statistics of the value of the yarn produced in every country, England's position would be at the top of the list by a long way and India very far down.

Again, it so happens that the Empire's production of cotton in 1932-33 was almost identical with its consumption in the same season (5,025,000 bales against 5,057,000), but this by no means implies that the Empire's cotton industry is self-supporting in raw material. India is in this respect to a very large extent self-supporting, but only uses about half of her own crop (2,268,000 bales out of 4,516,000 in 1932-33), leaving 367,000 bales of other kinds, divided between American, Egyptian, East African, and other types. Of the United Kingdom's consumption of 2,248,000 bales, 1,400,000 bales were American, 301,000 Egyptian, 225,000 Peruvian, Brazilian, Argentine, Turkish, Russian, and other kinds, but only 197,000 bales of Empire sundries and 126,000 of Indian were included. Here again the question of the bale weight comes in, for the 5,025,000 bales produced in the Empire weighed only about 2,010,000,000 lbs., while the 5,057,000 bales consumed weighed approximately 2,313,000,000 lbs.

But apart from all these statistical refinements, the fact remains that the cotton grown in the British Empire plays a far more important part in the world's supplies as a whole than the figures indicate. It must be remembered that the world's cotton supplies are not a homogeneous total, but consist of many different kinds of cotton with a range of values as wide as the different uses to which they are put. It is possible to divide the crops into four main groups, and in each of them the Empire is producing quite a material share.

Formerly the cotton world was divided into three more or less watertight compartments—Indian, American, and Egyptian—and the major cotton-spinning countries were as clearly segregated from one another in the kind of cotton they mainly used. The United States used practically nothing but American, England consumed mainly American and Egyptian with very little Indian, while India depended almost entirely on her own crop, and China and Japan, where the industry was very small, used practically nothing but Indian and their own local crops. On the Continent the bulk of the consumption was American.

With the development of cotton-growing in the Empire and in the colonial possessions of European countries there was a complete change. Most cotton-growing countries now produce several different kinds of cotton, while the crops of many of the new producing countries, though individually small, in the aggregate are considerable, so that today no country has a monopoly in the production

of one kind of cotton and no cotton-consuming country is dependent on one source of supply. The world's crops are no larger than they were in 1914, but they are much more varied, and in every group dominated by one principal crop there are many other smaller competing crops. Further, many of these smaller crops lie between two groups, like Peruvian and East African between American and Egyptian. In consequence the price and the consumption of every kind of cotton depend to a far greater extent than formerly on the production and the price of several other kinds of cotton.

It is just because the Empire supplies are so widely distributed over every one of the principal groups that they have retained an importance quite out of proportion to their volume. Thus, beginning at the lower end of the scale of value, the Indian crop must be divided between at least two groups. The shorter stapled varieties are mainly consumed in India, China, and Japan, and a fair amount is taken by the Continent, but very little by England. Actually these short staple Indian cottons are to a great extent used either in conjunction or in competition with waste from longer stapled cotton, such as American and Egyptian, in the production of very low count yarns.

About one-third of India's total crop, however, now consists of much better cotton of a staple of $\frac{7}{8}$ inch or above, and this type competes quite definitely with the lower grades of the American crop, much of which is now below an inch staple. These long-stapled Indian cottons first found a ready market in Japan as well as in India, but in recent years Lancashire's consumption of them has increased, especially when relative prices were favourable. Indeed, the most interesting development of the past year has been the efforts which have been made in Lancashire, under the stimulus of a special committee established as a result of the Ottawa Conference, to develop the use of Indian cotton in Lancashire. At the British Industries Fair at the White City in February some remarkable illustrations of its use were shown, including fabrics made from the short-stapled Indian cottons, which in quality and finish compared very favourably with fabrics produced from American cotton.

The substitution of one cotton for another is of course always a question of relative prices, and it may be noted that, owing to comparatively small crops in India in recent years, the price of Indian has for a long time been relatively high compared with American. Even the 1933-34 crop, which for a time showed prospects of a substantial improvement on the low figures of recent years, proved disappointing again, and the Government's final estimate was only

4,970,000 bales against 4,656,000 last year. These figures make a very poor comparison with the record of 6,215,000 bales in 1925-26.

The Empire is numerically weakest in the second of the four groups, American, which forms about 60 per cent. of the world's total production, the Empire's only contributions to this grade, apart from Indian long-staple cotton, being the small crops of the Sudan (American), Nigeria, Nyasaland, Rhodesia, South Africa, and Australia. It is encouraging to note a very satisfactory recovery in the Nigerian crop of 1932-33, for in the previous two years it had dwindled far below its previous record of 48,000 bales. South Africa's crop, however, was the smallest for many years. From Australia, on the other hand, there are reports of a crop of 20,000 bales in 1933-34, which would create a record.

The largest of the new Empire crops is the Uganda, which is in a higher grade of classification, as with Peruvian, part of the Brazilian crop, and the better grades of American cotton it competes to some extent with Egyptian Uppers. It is very satisfactory to note that in the last two seasons Uganda has established new record figures. Tanganyika also has made a good recovery in these years. The East African producers, however, feel that the development of their crops is handicapped by the relatively high freights charged by the East African Shipping Lines Conference on cotton from their ports. The freight on cotton from Mombasa to the United Kingdom is 30s. per ton of 40 cubic feet, while from Bombay, where competitive conditions rule in the freight market, it has been as low as 17s. 6d. In view of the very heavy rail freight which the Uganda crop must bear before it reaches the coast, it is probable that the proportion of the final price which goes in freight charges is higher in East African than in any other cotton in the world. Transport has, of course, always been the greatest obstacle to the development of Empire cotton in Africa, and the good progress which is being made in the construction of the Zambesi Bridge is welcome, as this bridge should lead to the extension of cotton-growing in Nyasaland.

Of a still higher grade are Sakel and the other long staple varieties of the Egyptian crop. After a declining period, the Sakel crop in the Sudan showed a remarkable recovery in 1931-32 to a new record total, but this level has not been maintained since. Finally, at the upper end of this top grade is the very small but exceedingly valuable Sea Island crop of the British West Indies. The market for this crop is peculiarly sensitive to the fluctuations in demand for the luxury articles to which its use is confined, and two years ago the position was so bad that the islands had to adopt a definite policy

of acreage restriction to meet the reduced demand and assist the liquidation of accumulated stocks. That policy has been particularly successful, and during the past year there has been a definite recovery in the demand for Sea Island, partly owing to very energetic propaganda in the creation of new uses, such as the "Happy Valley" Sea Island underwear, and partly to the fact that Sea Island was at first largely used for the new "Lastex" rubber-cored yarns, for the covering of which extremely fine cotton was required. The latter development provides another illustration of the possibilities of substituting one cotton for another, as it is now evident that the best grades of Sakel can be used in place of Sea Island for this purpose. The reduction of stocks of Sea Island has also been greatly helped by the practical cessation of the production of Sea Island cotton in the island of Porto Rico.

It is satisfactory to learn that the cotton crops of the Empire (apart from India) in 1932-33 have established a new record, being over 500,000 bales of 400 lbs. There is reason to hope that 1933-34 will show at least as good a figure.

LEAF CURL DISEASE OF COTTON IN THE SUDAN

BY

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An article dealing with this subject, contributed by Massey and Andrews,* appeared in this journal in January, 1932, but, in view of the progress since made towards the control of this disease in the Sudan, it would appear to be worth while, at the risk of a certain amount of repetition, to attempt to summarize the history of this disease in this country down to the present time.

The origin of Cotton Leaf Curl disease in this country is still, and will probably remain, a matter for speculation. The effect of the disease on the growth of the plants is so striking, and the appearance of infected leaves so peculiar, that it is inconceivable that it should have passed unnoticed once it had gained a real hold on the cotton crop. We may confidently state, therefore, that the disease was unknown and probably non-existent in cultivated cotton in this country only eleven years ago.

The first specimen was collected in the Gezira in the season 1923-24, and during the following two years the finding of infected plants was still a very rare occurrence. In 1926-27 the disease showed the first definite indications of spreading in the Gezira, and in that same year its identity with the "Leaf Curl" of Nigeria was established.

By the end of the next season (1927-28) nearly fifty per cent. of plants were infected in areas where cotton had been grown for some years, and in the following season infection was general and severe, except only on land which had newly been brought under cotton. The next two seasons saw the completion of the process of penetration, and practically every cotton plant over the whole Gezira area—amounting to some 200,000 acres of cotton—showed more or less severe symptoms.

The most usual symptoms associated with this disease are a conspicuous thickening of the veins of the leaves and bracteoles, accompanied by a thin, spindly habit of growth and spiral twisting of the fruiting branches. In its most severe form it is capable of producing

* *E.C.G.R.*, Vol. IX., No. 1, 1932.

complete necrosis of the upper part of the stem, but more usually the plant continues to grow and throw up more and more twisted, contorted branches, almost completely sterile and bearing small crumpled leaves. Bolls that have been formed prior to the incidence of infection appear to be unaffected, so that the relative earliness or lateness of appearance of the annual wave of reinfection is a matter of very considerable importance.

This disease began to receive serious attention from the research staff in the Sudan in 1926. It soon became clear that it came under the category of " virus diseases," but the means by which infection spread remained obscure for some little time. White fly (Aleurodidæ), Jassids and Thrips all came under suspicion as likely vectors, but the earliest trials gave negative results in all cases, though a certain amount of evidence was accumulated which appeared to indicate that Jassids were of importance in this connection. Early in 1930, however, Kirkpatrick* succeeded in obtaining direct transmission through the agency of white fly, and his subsequent work has shown clearly that these insects are the sole carriers of this disease in this country.

Having established the identity of the vector, it became of paramount importance to discover the source from which the white fly itself becomes infected in the first instance.

It had for long been the practice in the Gezira to separate the successive cotton crops by a " dead season," lasting from two to three months. The cotton fields were dried out from April onwards and, when the last of the pickable cotton had been harvested, the stems were chopped off just above ground level and the roots left to die.

Meanwhile, it had been observed that the white flies themselves practically disappeared during the dead season, and that they could only be found in very much reduced numbers for some weeks prior to the cutting-out of the crop. Further, it was found that adult white flies could only remain alive, even under the most favourable circumstances, for two or three weeks at most, and that the virus was not transmissible through the egg from one generation to another.

It would seem that a very effectual barrier had been placed between the newly sown cotton of any one season and the infected crop which had preceded it.

It soon became apparent, however, that the cutting out of the cotton plants was not entirely effective and that, in a certain number of cases, the stumps or even severed portions of the roots were capable of surviving and of throwing up small stunted shoots infected from

* *Bulletin of Entomological Research*, vol. xxi., Pt. 2, July, 1930.

the start with the virus which had originally permeated the parent plant. The number of these "survivors" depended to a great extent on the amount of rain which fell on the old cotton land during the "dead" season, and there can be no doubt, also, that the then existing practice of taking a crop of millet or of "Lubia" (*Dolichos lablab*) on the old cotton land immediately after the termination of the dead season facilitated the survival of the cotton stumps. The irrigations given to these crops probably helped to "pull round" a number of the old cotton stumps, which would otherwise have died.

It became clear that a considerable measure of control of Leaf Curl should be possible if effective measures could be taken to reduce the carry-over of "ratoon" cotton to a minimum, but, meanwhile, it was necessary to decide whether any other important means of reinfection of the new-sown crop existed, which, if left uncontrolled, might vitiate the success of any campaign which relied only on the extermination of ratoons.

One obvious possibility lay in the seed, in which the virus might well have survived in a condition capable of passing on to the germinating seedlings. This was considered to be not very probable, in view of the comparative rarity of proved cases of seed transmission of similar viruses, and more particularly so in view of the already established fact that, except when seed was sown very late and surrounded by plants which had already taken the disease, no case of a young seedling being found infected had been recorded.

It was decided to put the matter to the test experimentally, but, meanwhile, until this had been done, it was considered to be safer to import Sakel seed from Egypt, a country which to this day has remained free from this disease—at any rate as far as the cotton crop is concerned.

The special tests which were carried out involved the collection of seed from particularly badly infected Sakel plants, and the growing of this seed in an area sufficiently remote from the main Gezira area to be likely to escape infection from odd white flies blown down on the wind, but sufficiently similar in climate and soil to be likely to provide conditions suitable for the development of the virus if present in the seed. A spot was eventually found some forty miles away from the nearest known cotton and about the same distance from the south end of the Gezira cotton area. The experiment, which was carried out by the Plant Pathologists, was repeated a second year on the same site, and altogether about 40,000 healthy plants were raised without any trace of Leaf Curl disease. It is clear that seed-transmission cannot be a factor of importance, though the possibility of its occurring

once in, say, 100,000 times cannot be entirely ruled out, and may help to explain the *original appearance* of the disease in entirely new areas.

As has been indicated previously, we have no clear clue to the means by which this disease first established itself in the Sudan. We have no positive evidence of seed-transmission, and even if we had, the fact remains that practically all seed introductions of types which are or have been grown in the Gezira have taken place from Egypt, where the crop is free from this trouble. The same virus disease is now known to occur on other malvaceous crops or garden plants—notably on " Bamia " (*Hibiscus esculentus*)—and on certain malvaceous weeds, and Mr. Massey has recently reported the finding of such weeds with symptoms of Leaf Curl in the Nuba Mountains district under circumstances which did not suggest that they themselves had been infected from cotton. It may be then that the disease has existed in the country for a long time on certain malvaceous weeds, which themselves are partially immune and only very occasionally infected. The fact that the local Bamia crop, grown in the country long before susceptible " foreign " cottons were introduced, did not develop the disease until about the same time as the cotton crop might only mean that the latter has supplied the necessary " bridge " between certain weeds and itself.

To return to the matter of control measures—the 1931-32 crop in the Gezira was sown with the newly imported seed, and, as a further precaution, the growing of lubia was practically dropped, and the millet crop was concentrated in special areas as far as possible away from the new cotton and avoiding the site of the cotton land of the previous year. Efforts were also made to destroy ratoon growths as they appeared, work which was definitely facilitated by the fact that the lubia and millet crops were no longer acting as a cover for these growths.

The level of infection in the Gezira dropped very considerably that season, and it appeared that the various measures taken had, either singly or in combination, been very fairly successful.

In the next year, however, despite similar measures, Leaf Curl was once more severe and widespread. The essential difference between the two seasons lay in the rain which fell during the dead season between the two cotton crops. In 1931-32 this early rain had been particularly light, whereas in 1932-33 the amount which fell during that same period was above normal. A correspondingly high percentage of stumps of old cotton plants survived and began to sprout vigorously by the time that the new cotton crop was in the ground

and starting to grow. There was no lubia to cover these ratoons and prevent their being seen, but the abundant growth of weeds produced by the heavy early rains had the same effect. Vast quantities of ratoons were destroyed, but many more escaped and passed the infection on to the new crop.

It became clear that there was no hope of checking effectively the growth of ratoon cotton with the existing methods except in dry seasons, and experimental work was turned to devising a hand tool which could be used by the native cultivators and which would be capable of pulling the old plants, roots and all, from the soil. Mr. Massey, in August, 1932, designed an implement which was definitely capable of doing this, and, after further trials and modifications, implements of this type were manufactured and used over the whole Gezira area at the end of the 1932-33 crop.

The dead season between that crop and the next (1933-34) resembled in general that of the season which had just passed in the amount and distribution of rainfall. The amount of ratoon cotton, however, was found to have been reduced enormously: a few did get through, due to the breaking-off at ground level of a very small proportion of the plants during the process of "pulling-out." The majority of these survivors were dealt with before the new crop was sown, but a certain number inevitably escaped, and in other cases the old rootstocks themselves did not push their sprouts above ground until later on when the new cotton had already been sown.

The appearance of Leaf Curl in the Gezira in the 1933-34 season was carefully watched for and its progress noted. In the previous year the first recorded case of Leaf Curl in the new crop had been noted on September 17, and records had become numerous by the first week in October. Now, however, the "first appearance date" was delayed until October 5, and for a very considerable time further individual occurrences were few and far between. Subsequent spread was relatively slow, and appeared to be due to local secondary infection derived from the earliest infected plants of the new crop, rather than to further infection from outside sources. White fly were present in large quantities, and it can only be supposed that their failure to bring about a rapid spread of the disease in the early stages was due to the fact that they themselves were in most cases not contaminated with the virus owing to the fewness of the infected ratoons.

Though later in this season the disease spread over large areas and was found in all parts of the Gezira, its lateness of arrival resulted in its doing only relatively little damage to the crop, and

we feel fairly confident that the very large improvement, due to the pulling out of old cotton roots and the general clean up, is likely to be a permanent one.

The danger, however, still exists and has to be met afresh every year, and, further, there is always the possibility of a considerable carry-over of infection on the perennial "Bamia," which is extensively grown by native cultivators as a food crop in the vicinity of the cotton fields.

Direct control of the white fly vector presents great practical difficulties, and it is, therefore, satisfactory to be able to record that considerable progress has been made towards obtaining strains of cotton immune from this disease. Asiatic cottons appear to be almost completely immune, and American cottons, as a class, show a fair degree of resistance, but at the time when the disease first swept the Gezira, none of the established varieties or strains of Egyptian cotton showed any marked superiority in this respect over the variety "Sakellarides," which had been adopted earlier as the type for planting in the Gezira area. Certain locally-selected substrains of Egyptian cotton were already in existence in the Sudan, but none were able to stand up to the disease, any more than were the wide range of new types subsequently introduced from Egypt with the hope of discovering a naturally resistant strain.

Crossing with Asiatic forms is a matter of the very greatest difficulty, and crossing with the less widely separated American type, though perfectly feasible, would have necessitated the elapse of a very considerable period of time before the desired combination could be fixed. Attention was therefore devoted to individual plant selection within the Sakel crop itself, amongst certain pedigree families of Sea Island cotton which were being grown on the experimental farm at Shambat, and amongst the various progenies derived from certain crosses which had been made at an earlier date between Sakel and Sea Island.

In the season 1928-29 systematic selection was carried out in an area containing many thousands of Sakel cotton plants, and, altogether, seed of 170 separate plants was collected. In the following season the progenies gave little evidence of resistance to disease, and it became apparent that the absence of symptoms in the parent plants was, in a very large number of cases, due to the fact that those particular plants had been accidentally stunted in growth. It has been shown that it is characteristic of this disease that the symptoms can only manifest themselves in actively growing shoots. Fully developed organs can be infected with the virus by the white fly

carrier, but the evidence of infection is not obtained until new organs have been differentiated from the meristematic tissue.

Although, actually, none of the selections referred to above have since been carried on, other selections proved more successful. Individual plants of various Sea Island strains showed evidence of a considerable range in degree of susceptibility; some of the hybrids between these and Sakel produced the most severe cases of the disease that have yet been met with—the whole of the tops of the plants being killed off; others, on the other hand, were decidedly more resistant than Sakel. Continued selection has tended to produce plants with still greater resistance, and a number of strains and substrains are now in existence which are decidedly more satisfactory than Sakel in this respect.

The work of the Plant Breeding Section in the Sudan acquired a new bias, and all pre-existing selections and their derivatives were combed-out with the idea of eliminating all types that showed undue susceptibility to the disease. Amongst those that remained several showed a very promising degree of relative immunity.

Leaf Curl is by no means the only factor which is capable of affecting seriously the yield of cotton in the Gezira, and in 1926-27 a plant had been selected which was capable of withstanding, to a much greater degree than Sakel, the peculiar conditions which occur in certain seasons in that area. The progeny of this selection, which was made from a crop of ordinary Sakel in the Gezira by Mr. A. R. Lambert, was already growing on the breeding station at Shambat in 1928-29 when Leaf Curl disease first became general. The individual plants in this progeny were found to vary very greatly in susceptibility, and two of them showed considerable resistance. These two plants have now given rise to two strains of cotton, known as " X1530 " and " X1730," in which the relative degree of immunity shown by the original subselections has been retained, the former strain being more resistant than the latter. In lint character these new strains agree closely with their Sakel prototype, and we are, therefore, now in possession of cottons of Sakel type, but of outstanding vigour and fruitfulness, and which also combine with this a very high degree of resistance to Leaf Curl.

The following figures, representing the percentage of plants infected in Sakel and in various new strains, including " X1530 " and " X1730," growing in a small replicated field trial in the Gezira in 1932-33, may be quoted from the annual report of the Gezira Entomological Section for that year, as indicating the degree of resistance shown by some of these new types. The count was made at the end of November, 1932, some two months after Leaf Curl disease first

appeared in that plot. Each of the new strains was sown in small square plots (replicated), surrounded on four sides by similar plots of Sakel cotton.

PERCENTAGE OF PLANTS INFECTED WITH LEAF CURL.

Name of New Variety.	*In New Varieties.*	*In Sakel Control.*
XH730	17 per cent.	70 per cent.
X730	12 ,, ,,	64 ,, ,,
XO4729	11 ,, ,,	70 ,, ,,
X1730	8 ,, ,,	74 ,, ,,
X1530	6 ,, ,,	44 ,, ,,
Lecrem	6 ,, ,,	72 ,, ,,
X1030	6 ,, ,,	70 ,, ,,

The figures given for percentage infection in the new varieties show very big decreases when compared with the figures for the control plots, but when these same varieties are grown in larger plots, *not* completely surrounded at close quarters by the very susceptible Sakel type, the plants tend to protect each other, and even better results are then obtained. This may be illustrated by the following further percentage infection figures, relating to a chequer-board variety test in the same season. The figures in this case were obtained three months after the disease first appeared:

PERCENTAGE OF PLANTS INFECTED.

Sakel	91·5 per cent.
X1530	3 ,, ,,
X1730	2 ,, ,,
X1030	2 ,, ,,

The results given above are extremely encouraging, and, more recently, progress has also been made through the means of hybridization.

A variety of *peruvianum* cotton, known as "Ishan," had been selected and established in Nigeria, and was reported on as showing a considerable power of resistance to Leaf Curl in that country. Seed was imported into the Sudan by the Plant Breeding Section at the time when the disease first became important in the Gezira, but the performance of this type during its first few years in the country was poor and did nothing to offset the quality of its lint, which is harsh and very short compared with Sakel. In 1932-33 and in the following year, however, small plots of this variety gave surprising evidence of the ability of this cotton to withstand the unfavourable conditions which obtain in the Gezira in certain years. The quality of the lint was as unattractive as ever, but the resistance to Leaf Curl was very clearly demonstrated.

Crosses had been made in the 1931-32 season with Sea Island cotton, and selfing and backcrossing were carried out in the offspring. None of the resulting types are yet fixed, but much promising material has been obtained, which should, in time, widen very considerably the field from which types fully suited to the Gezira and endowed with a very high degree of resistance to Leaf Curl can be selected for final distribution.

The growing of resistant strains, in combination with the employment of the hygienic methods described earlier, should reduce Leaf Curl disease in the Gezira to insignificant proportions, and it is legitimate to hope that a period of twelve years will have witnessed not only the appearance and sensationally rapid spread of a very serious disease of cotton, but, also, its disappearance as a factor of any importance in crop yield.

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COTTON GROWING IN UGANDA

BY

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PART II.

FIELD WORK OF THE AGRICULTURAL DEPARTMENT.—The organization of the Agricultural Department consists of a Headquarters Staff, a General or Field Division, an Education Division, and a Laboratories Division.

The Field Division is divided into two groups or divisions, the Eastern and Western divisions, each group being in charge of a Senior Agricultural Officer, who controls a staff of European Agricultural Officers, African Agricultural Assistants, and African low paid inspectors.

With the increase in staff of the Field Division in the last few years—thanks in great measure to the assistance of the Empire Cotton Growing Corporation—development of the work of this division has proceeded apace, more especially in the Eastern Province, where, so far, the greater part of the staff has been stationed.

Apart from the normal routine work of a field officer in stimulating production along sound lines by advice and propaganda, through the chiefs and by means of his native staff, three major items of the work of the Field Division in respect of cotton are (*a*) organized distribution of cotton seed to the growers; (*b*) estimation of acreage under cotton; (*c*) estimation of the probable crop.

In the matter of cotton seed distribution, the Government have very wisely retained full control over the variety planted in any area. In the first place, the importation of cotton seed without the prior sanction of the Director of Agriculture is prohibited. Secondly, the Government has power to requisition any cotton seed for planting and to distribute the seed free to the growers. Thirdly, no person may grow any cotton from seed which has not been supplied to him in accordance with the directions of the Director of Agriculture.

In normal areas where no new strain is being run through, the procedure is as follows. Prior to the opening of the cotton-buying season, requisitions are made on the various ginneries specifying the amount of seed which they must reserve for distribution to growers.

This seed is reserved from the earlier buyings, these being of good quality and hence the most viable seed. From the ginneries in some areas the seed requisitioned is then transported to cotton seed stores erected by the Native Administration, and distribution to the growers takes place under the supervision of the chiefs. In other areas organized distribution of seed takes place from the ginneries direct.

With the development of cotton-breeding work—again largely as a result of the assistance rendered by the Empire Cotton Growing Corporation—it became necessary to organize the increase and distribution of new strains into general cultivation.

In respect of the Eastern Province a scheme was put into operation in the 1929-30 season which provided for the complete change of seed in that Province once in eight years. Subsequently, the scheme was modified so as to speed up distribution, and is now in operation on the following lines:

From the Serere Experiment Station the seed from 30 acres of the strain selected for "general release" is planted by growers in a small peninsula running out into Lake Kioga. This area has been proclaimed under the cotton legislation as a segregated area, in which the planting, marketing, and ginning of all cotton grown therein is under the direction of the Director of Agriculture. This peninsula has been segregated from other adjacent cotton-growing areas by the creation of a thousand-yard-wide no-cotton belt demarcated by two parallel plantings of *Euphorbia candelabra*. The cotton, approximately 400 to 500 acres, in the first segregated area is then ginned separately and the seed next distributed into an adjacent larger segregated area in which approximately 4,000 acres are planted. The seed resulting from the separate ginning of the cotton from the second segregated area is then distributed to growers in a third and largest segregated area estimated to produce 25,000 acres of cotton, and from which, at a conservative estimate, 1,250 tons of seed can be expected. This tonnage is sufficient to effect a complete change of seed in one-third of the cotton-growing areas in the Eastern Province.

With distribution of new seed in such an amount it was realized that, as the whole of this is the production of a few ginneries in the segregated areas, those ginneries would be robbed of any value of the seed which could have been obtained by sale to seed exporters; and in late years exports of cotton seed from Uganda have been expanding. The value of such seed has been in most cases passed on to the grower. It followed, therefore, that if this 1,250 tons

was requisitioned without payment, the growers in the segregated areas would suffer. Conversely, the growers or the ginneries in the large area in which the new seed was to be distributed would benefit to the amount of the value of the seed which was not needed for distribution in that particular year.

In order to overcome this difficulty, legislation was enacted whereby Government could requisition seed at all ginneries as before; but if the seed was not distributed to growers, Government could sell the seed so requisitioned and the proceeds could be utilized to pay for seed requisitioned in the segregated area, the ginneries in that area being paid market rate for the 1,250 tons so requisitioned. The costs of transport of the seed, which are substantial, are borne by Government.

With the extension of cotton-breeding work to Bukalasa in 1930, the possibilities of a similar scheme for Buganda Province are being explored.

Acreage and Crop Estimation.—In a country such as Uganda, where so far cotton can be said to be the life blood of the country, it will be realized that the volume of the crop has repercussions in all sorts of directions. For example, amongst other things it affects the bazaar trade and the importing houses at Mombasa, it influences the specie requirements of the various banks which finance the purchase of the crop, and a fairly reliable forecast of the crop is almost a necessity for purposes of Government and railway budgets. It will be realized, therefore, that, with the increase in the crop, the figure of acreage planted is of great importance to the various business interests.

With the size of cotton plots varying from a fair-sized drawing-room to as much as twenty or thirty acres, and with something like four million individual plots to contend with, a close estimate of the actual acreage is a matter of some difficulty. Natives were originally advised to plant in square plots on the basis of quarter acres or acres measured out with native ropes. So long as this method was used, and even so long as the average size of plot did not vary, the published figures of acreage were of value as indicating the proportionate increase or decrease in the acreage planted, provided that the conversion basis from plots to acres was not altered.

In 1929, however, it was decided that a closer estimate should be worked out, and a system of sample measurements was evolved which under conditions such as exist in Uganda gives a reasonable approximation of cotton acreage in the Eastern Province. On account

of lack of staff, this system has not yet been put into operation in Buganda and parts of the Northern Province.

The method employed is as follows: The chiefs report to the District Commissioner the actual numbers of cotton plots irrespective of size which have been planted in their areas each month. The native inspectors of the Agricultural Department are then detailed off to make check counts in several mulukas, a muluka being an administrative unit in charge of a minor chief. In addition to this check count, the inspector paces out in two directions, average length and average breadth, all the cotton plots in a mutala of the muluka checked (a mutala being a smaller administrative unit within a muluka, and containing probably about 200 plots of cotton). The tabulated measurements are then sampled by the Agricultural Officers and reduced to 100 measurements for each mutala.

The average size plot is then calculated and is taken as being the average size for that part of the district. These various averages are then weighted according to the number of cotton plots in the area which they represent, and from this an average district plot size is obtained. This district average is then applied to the total number of plots in the district, and the total acreage computed. Should the check count of the number of plots indicate a false return by a chief, a recount is made and the returns corrected, and the chief duly brought to book.

This method has produced some rather interesting results in showing the increase in size of plot where ploughing is carried out, and in the case of food crops has shown the decrease in size of plots of certain crops susceptible to attack by locusts and the increase in the plots of crops that were immune* in the second year of the recent invasion by the migratory locust.

Following on the establishment of a system of acreage computation, an attempt is now being made to evolve a reliable system of cotton crop estimation.

The method actually used for the past three years has been one of applying crop condition indices to the various districts on the basis of condition above or below average, and condition above or below previous year. Figures of average yield per acre are worked out by districts from the figures of acreage and total purchases at all ginneries and markets in the area. The two results so obtained are compared, adjustments are made, and finally a 5 per cent. deduction is made, and the first estimate published refers to the crop

* Such as (usually) cotton, dwarf types of groundnuts, sweet potatoes, and manioc.

at the end of November at a stage when picking of the crop has just commenced, and at a period about six weeks before the opening of the cotton-buying season. The estimate is modified in each succeeding month, depending upon an alteration in crop condition. This method has proved fairly successful, but it is desired to evolve a system which is independent of personal opinion, and for the past two seasons a method has been tested out which it is hoped may prove effective.

Under this system, about the end of November the various agricultural officers traverse their areas by car in two directions, and, at certain regular intervals according to the mileometer, stop, and in the nearest cotton plot, irrespective of size, shape, or condition, take certain observations on ten plants in the tenth row of cotton. These observations include distance in inches between ten rows, number of bolls from each of the ten plants (a boll including flowers which have turned pink—*i.e.*, the previous day's flowers), picked bolls, and all intermediate stages. In addition, a boll analysis is made on ten bolls of various stages of development, the total number of loculi, and sound and diseased loculi being noted. The seed cotton from ten mature bolls is picked and forwarded to the botanical section, together with the details recorded, and the botanical section then correlate all the information, apply the results, and frame an estimate.

It is too early as yet to state whether this system will prove effective, but interesting results have been obtained and the great variation in spacing in the different districts has been shown up.

Within the last few years the Protectorate has been invaded by the pink bollworm, and in spite of all efforts made by restricting the movement of seed cotton, this pest has now spread over a considerable part of the cotton-growing areas of the Protectorate. It is as yet too early to gauge the damage which it is likely to cause to the crop, or to indicate measures which will be taken to control it, but a close study of the bionomics of the insect is being made by the Entomological Section.

In conclusion, it is not too much to say that, in the matter of volume of production, the effect of the world depression of prices has been largely instrumental in causing the rapid increase in cotton production in the past few years. Uganda native agriculture is in the happy position of not having to balance "costs of production" against "gross sale receipts," and when the "rate of exchange" for human labour, expressed as cotton produced, fell in terms of the East African shilling, the effect was simply to stimulate increased

production in order to maintain the same net return and standard of living which had been largely established in a period when cotton-growing was " easy money."

As in all countries, the native agriculturist grows the crop which pays him best, and so far, in the case of the majority of the native producers of the Protectorate, cotton maintains its pre-eminence as the favourite " cash crop."

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THE TIME TO PLANT COTTON IN NYASALAND

BY

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In a country where cotton is essentially a peasant producer's crop, the native point of view is all-important agriculturally and economically. The strength of Nyasaland as a cotton-exporting country lies mainly in its possession of a large native population which is self-supporting on the land and relatively independent of world conditions in general. This means, however, that the primary necessity of a native's life is to provide a food supply for himself and his family; cotton, therefore, or any other crop which cannot be used for food, must always be a secondary consideration to him.

The climate of Nyasaland is of the monsoonal type, and the year may be divided into two periods: the "wet" season from December to April inclusive, when the bulk of the annual rainfall is received; and the "dry" season. Being south of the equator, the country receives its rains in the summer, and the early part of the dry weather which follows forms the winter season. The latter part of the dry weather has a gradually rising temperature, and the hottest time of the year occurs just before the rains break in November. The grain crops, which form the bulk of the native's food supply, must be sown at or soon after this time, and there results a seasonal rush of work when all else must be subordinated to the vital food crops.

An attempt has been made in a previous article* to classify the present and potential cotton areas of Nyasaland under, among other headings, the planting periods. It was shown that the "summer" areas sown at or soon after the break of the rains are the most important; they are followed by the "semi-summer" or intermediate mid-season areas sown in January-February, and some lesser areas provide conditions which make possible a "winter" crop sown as late as March-May.

Certain parts of the country, confined for the most part to the Shire valley and to the Lake Nyasa basin areas in the Nyasaland section of the great Rift valley, possess soil and/or climatic conditions which render possible the growth of the out-of-season crops classified as "semi-summer" and "winter." The Lower River, comprising

* *E.C.G.R.*, Vol. IX., No. 3, 1932.

the Lower Shire and Chikwawa districts, provides what is probably the best example of these. On the Lower River there is to be found (1) land which is liable to flood during or soon after the rains, (2) land which is naturally sub-irrigated by the river Shire or its tributaries (these two examples form what is known in the vernacular as "Dimba"), and (3) land dependent entirely on rainfall for its moisture supply, which is known as "Mphala." Both types may be subdivided into various groups according to soil variations, but this subdivision is most marked in the case of the Mphala, where there are two very distinct soil types, one sandy and friable, the other more heavy and retentive of moisture. Practically all the Lower River soils in the cotton-growing areas are of an alluvial nature.

There is a further complication on the Lower River in the rainfall. In addition to the main monsoonal rains, which commence about the beginning of December and finish around mid-April, there occur late rains in May-September in certain seasons (about five out of the past eleven), which are sometimes effective in stimulating the growth of crops, especially of cotton.

As a result of all this one finds a medley of cropping practices. Early and late food crops are grown, the latter especially in "Dimba" lands, but according to the rainfall the seasonal distribution of crops may be extended to the "Mphala" areas. The Lower River native is therefore able to distribute his eggs among several baskets, but while his crop production is thereby made fairly safe (the large population carried by the Lower River is a proof of this), he is occasionally led into indiscretion in the matter of late planting on lands and under conditions which do not justify this practice. This indiscretion is most marked in the case of cotton, a crop grown entirely for cash sale, and therefore not given quite the serious consideration that is received by the food crops.

An important point is that cotton sown early in the rains, in December, tends in the humid climate of the Lower River to be very heavily attacked by insect pests, and in addition extravagant growth often results. The native discovered this before its implications were understood by the European, and modified his planting practice to meet it. Later-sown cotton tends to escape the worst of the insect attack, which dies away as the dry season advances, and if the moisture supply is adequate, may then provide a very useful crop. This "if" is, however, the critical factor, and the native is often tempted to sow so late that on "Dimba" which for some reason or other is dry, or on "Mphala," an almost complete or even a complete failure of crop results if there is no effective late rain. This has been the

case in the past three years, when lack of effective late rain has made the late-sown cotton (March-April) a failure on the sandy " Mphala " between Port Herald and Chiromo; and even mid-season cotton sown in January-February has failed or partially failed owing to the cumulative effects of several seasons of short rainfall on the sub-soil water content. Such failure of mid-season or " semi-summer " crop cotton did not, however, occur on the heavier types of "Mphala," or on dry " Dimba " lands of satisfactory texture, which provided the greater part of the cotton crop on the Lower River in 1933.

The position of cotton as a native crop on the Lower Shire is somewhat complicated, and it is easy to understand how several schools of thought have arisen as to the best time of planting, especially since the dryness of the past few seasons has tended to an earlier natural control of the pests, even on cotton planted in December. This control may also be due to some extent to the usual close season for cotton having been naturally lengthened by a crop which finished early.

The safest practice appears to be that of the happy medium, " semi-summer " crop cotton; and existing evidence points to the necessity for selecting cotton land with greater care than in the past. The sandy alluvium of the " Mphala " on the western side of the Shire river—of which the high-level section of the Port Herald Experimental Station is typical—is probably better suited to ground-nut cultivation while the rainfall remains on the short side. If, however, the " wet cycle " returns and sub-soil moisture reserves are recouped by a seasonal rainfall of 40 inches or more, cotton may come into prominence again as a money crop in this area. The well at the Experimental Station, which after providing a certain supply of water for several years, has dried up annually since 1930, may prove a guide. In the meantime all efforts will be made to confine the cotton crops, in so far as the " Mphala " land is concerned, to the heavier and more retentive types of soil, of which there is a large area to the north of Chiromo.

The " Dimba " areas will always be a gamble, and are best left to the native, provided always that emphasis is laid on his use of this land as a food-producing area. The advice given by Mr. E. Lawrence, formerly District Agricultural Officer, Lower River area, that " Dimba " cotton be planted earlier than is usual—*i.e.*, planted as a " semi-summer " rather than as a " winter " crop—and the gardens then replanted if a late flooding makes this necessary, is very sound.

One very great advantage of the " semi-summer " and " winter "

crop cotton it that it makes possible a practice of which the natives are very fond, that of mix-cropping cotton and various food crops, or taking a catch crop of cotton after the food crops have been removed. This practice is excellent from the native point of view, since one cultivation suffices for several crops, and it is also found that cotton, which makes its main growth after the heavy rains have ceased, is but little troubled by weeds. It must, however, be understood that unless cotton is grown as a pure stand, under whatever conditions of planting, optimum yields per acre are not to be obtained, though under certain conditions mixed or catch-crop cotton may give very good returns. The native's point of view is that he is able to grow his cotton with the minimum of exertion, while causing the least possible interference with his food crops. He may find small returns most satisfactory, but from a European standpoint his crop may be considered a comparative failure.

The Lower River area is essentially one for the "semi-summer" or "winter" crop. While the upper reaches of the Shire and the Lake Nyasa shore areas are also to some extent suitable to "semi-summer" or "winter" crops, the cotton areas of Nyasaland outside the Lower River are primarily "summer" crop areas, this being mainly due to temperature considerations. The Lower River is for the most part less than 300 feet above sea-level, while the remainder of the Nyasaland cotton areas are 1,500 feet or upwards. Further, the late rains which often occur on the Lower River do not reach the up-country areas, and "Dimba" development is restricted to the flood plains of rivers which drain to Lake Nyasa, or to the banks of the Upper Shire. The only really large development of "Dimba" conditions is in the North Nyasa District near Karonga, where the effects of a low latitude tend to offset the effects of elevation on temperature.

The great disadvantage of "summer" crop cotton from the native's point of view is that it competes directly with his food crops in its demand on his time and energies, and for that reason there will not be the same intensive development of cotton in "summer" crop areas as has occurred on the Lower River. Against this the up-country areas are much larger, and the insect pest cycle is probably of shorter duration in these areas than in the more humid climate of the Lower River, and typical "summer" crop areas have an advantage over the "semi-summer" and "winter" crop areas in that the early finishing of the crop makes automatically for an extensive close season. This latter must have a considerable effect on the insect pest population.

Efforts to help the native in his time-factor problem are proceeding along various lines, one of the most important of which is the improvement of his strains and of the variety of his foodstuffs. The locust invasion from which Nyasaland is now suffering may be a great help in that it tends to cause a greater use of root crops; and work in growing such crops as cassava and sweet potatoes does not clash with the demands a cotton garden makes on a native's time. Heavier-yielding strains of maize will enable a reduction of food-crop acreage to take place, while the introduction of " Macheweri " (*Pennisetum typhoideum*) to the Lake shore areas, where it is unknown, should help the native a great deal.

The Domira Bay Experimental Station is well placed to study the problems of all three types of cotton cultivation, with an emphasis on the " summer " cropping practice. Breeding work at this station is being directed to the production of early types of cotton which will make a crop before the insect attack reaches its zenith, and to long-term drought-resistant types which may be more suited to the Lower River than U4, the variety now in use as a main commercial crop. U4 is primarily suited to the " summer " crop areas. A very quick-maturing " summer " crop strain may be of great use in allowing a later planting than is usual with " summer " crop cotton, and will enable the native to deal with his food crops before planting his cotton garden.

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THE WORK OF THE ST. VINCENT COTTON STATION

BY

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Introduction.—The history of scientific work with cotton in St. Vincent dates from 1915. Before that date selection of heavy bearing, representative Sea Island types had resulted in a high degree of purity of the cotton from the commercial point of view. Agriculturally, however, the type had many defects. It was susceptible to Angular Spot (Black Arm), and shed a great deal. Since the rainfall of St. Vincent is over 100 inches a year, and the cotton was sown in June and July, great humidity was experienced during the growing season, and heavy losses were suffered from disease. The two worst diseases were: (*a*) The internal boll disease due to cotton stainers; and (*b*) angular spot or blackarm (external boll disease).

In 1917 it was decided to attempt to control the cotton stainer by cutting down its chief wild food plants, Eriodendron and Thespesia. These control measures saved the industry, and since then there has been practically no trouble from stainers. The yield went up considerably, and with improved types a yield of 400 lbs. of lint per acre has been recorded.

Pure Lines Resistant to Angular Spot.—The writer began work in St. Vincent in 1915. The first task was to investigate the cause of the low yield of cotton, and it was found, as stated above, that the two diseases, internal boll disease and external boll disease, were chiefly responsible. The second task was to attempt to control Angular Spot through the breeding of resistant varieties.

A large number of single plant selections were sown out in 1915, and records kept of their reaction to angular spot. All the lines were badly attacked, and it was considered improbable that a resistant variety could be obtained by the method in which wilt resistance was obtained in America—*i.e.*, by the mere selection of single unattacked plants. Another line of attack was planned in 1916. A large number of single plant selections were sown out, and a record kept of the number of plants attacked by angular spot at weekly intervals from sowing. It was noticed that some lines showed 100 per cent. attack almost immediately, but others were attacked at varying rates. Two lines

were selected which showed 100 per cent. attack latest in the season, and a number of single plant cultures (selfed) were planted from each of these rows in 1917. Comparison with controls showed that some of the descendant lines of these two groups preserved freedom from attack long after the controls were 100 per cent. infected. Selection of lines subject to attack latest in the season led to the isolation of two very resistant lines, AB and AN. The same method of selection was initiated with the Superfine strain V135, and when the writer left St. Vincent in 1920 the question of resistance to angular spot was regarded as solved. Since then, in spite of the heavy rainfall, this disease does not give much trouble.

When a resistant variety to other diseases has been obtained in other plants, it has usually occurred suddenly—viz., as one or more single immune and relatively pure breeding plants. The St. Vincent history shows that resistance to angular spot does not occur in this manner, but has been obtained by the selection of small modifications in the required direction.

It is interesting to note that some of the St. Vincent resistant types have been used for crossing with Egyptian in the Sudan, and that the adoption of the above method of selection has led to the production of strains of Upland in Uganda resistant to angular spot. The most important feature from the plant-breeding point of view is that resistance does not, as in resistance to rust in wheat, depend on one or two genes, but more probably on a complex of tiny genes which have little or no effect singly, but which have cumulative effect.

Control of Internal Boll Disease.—The cutting out of native food plants of the cotton stainer had an immediate beneficial effect. In the 1916-17 season the percentage of stained cotton was 25 per cent., but in 1917-18, 14·5 per cent. In 1922-23, an exceptionally favourable season gave a yield of 162 lbs. of lint to the acre, on an area of 3,562 acres, a yield which had previously been exceeded once only in the history of the industry (1906-7 with 174 lbs. of lint per acre).

In this year the percentage of stained lint dropped to between 5 and 6 per cent. By 1920, when the writer left the Island, there were a number of strains in an approximately pure condition, selected for various purposes, and work was just beginning which had as its object the combining of the desirable characteristics of the strains isolated.

On the writer's return to England in 1920 the work was carried on by Dr. T. G. Mason, a member of the staff of the Imperial Department of Agriculture for the West Indies. Later on the Empire Cotton Growing Corporation took over responsibility for the work, and appointed Mr. L. H. Burd to the post in 1922. The pure lines were

kept going until 1926, when the Corporation decided to close down the Station. Between 1926 and 1930 some admixture took place in the pure lines, and Professors Ballou and Cheesman suggested the recommencement of the work. The Corporation therefore reopened the Station in 1930, with Mr. S. H. Evelyn as the Officer in charge, and the writer in technical control of the experimental work. The first task of the Station was to purify the unsatisfactory welter of Sea Island types which composed the commercial crop of the Island.

The cause of deterioration was that two strains were in existence on the Island side by side—namely Superfine, with standard lint length about 57 mm., and ordinary, with lint length about 51 mm. Insufficient care had been taken to keep the two apart, and natural crossing and mechanical contamination had caused both types to lose their good qualities.

Examination of the strains grown at the Station in August, 1930, by Mr. Evelyn demonstrated that some of the pure lines isolated in the years 1915-20 were still fairly pure. It was decided to carry on representative types which could later be used in breeding, and meanwhile to concentrate mainly on purification of the standard superfine type.

The method of selection devised by the writer termed the "bulk sample method" was used. This particular method of selection was first published in 1920, and it may be desirable to devote some explanation to it here.

The bulk sample method consists of an examination of a sample of seed cotton made up of approximately equal quantities from each plant of a progeny row. Such characters as weight of lint per boll, weight of seed cotton per boll, and ginning percentage are usually determined on a random sample of 100 bolls from the progeny row, taking approximately equal numbers of sound, healthy bolls from each plant. Weight of lint per seed and seed weight are determined on 300 seeds. Mean maximum lint length is determined on 25 seeds taken at random from the bulk sample.

The mean by the bulk sample method is approximately the same as would be obtained by averaging the results of a single plant examination. If the mean value of a given character is low in the bulk sample it will also be low on single plant examination, since a low mean can only result from a summation of low values of individual plants.

The value of the method will now be realised, since it is possible to transfer the basis of selection from the single plant to the mean of the strain, and undesirable strains can be eliminated forthwith on the results of the bulk sample test.

If it is desired to isolate the highest possible lint length from a mixed population the procedure would be as follows:

1. Grow say 1,000 progeny rows of 20 plants each from 1,000 plants with high values selected from a commercial field.
2. Perform a bulk sample test for lint length on each progeny row.
3. Select the 10 rows which have given the highest mean lint lengths and grow *all plants* in progeny rows the second year. This will give 500 progeny rows, assuming 50 plants to a progeny row.
4. Perform bulk sample test as before and continue in the same manner.

By adopting this method the maximum amount of progress can be made in the selection of a given character with great saving of time and labour. Not only will the highest possible values be obtained, but the resulting strains will approach genetic purity at a rapid rate, since selection of high means will automatically eliminate strains of high coefficient of variability, as the latter will tend to be heterozygous and contain segregates of lower values.

In Sea Island cotton the method has been applied to the isolation of strains with long lint, high lint index, and high weight of lint per boll. With some modification the method can also be applied to the character mean number of bolls per plant. Here it is merely necessary to grow a large number of progeny rows from the row or rows giving the highest yield, and the method does not differ essentially from the "ear to row" methods of cereal breeding.

Purification of Sea Island Superfine.—Since the bulk sample method was employed, the steps of the purification process will be of some interest.

Examination in 1930 of 50 selections for lint length of the alleged pure Superfine strain V135 gave the following results:

Number of Plants with Following Lint Lengths in Mm.

46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
	1	1				1		1	1	4	11	17	10	3

Here it will be seen that at least 10 per cent. of the plants were below the 57 mm. standard. All the above plants were grown in progeny rows in 1930-31 and gave results on bulk sample examination as follows:

Number of Strains with Following Mean Lint Lengths in Mm.

46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	*Mean.*
	1	1				1	1		3	4	13	16	18	2	57·0

The means of the strains varied from 47 to 60 mm., and eleven strains were below our set standard. Single plant analyses were

performed on the eight best strains, and the two best of these strains were selected to continue in 1931-32, growing the six best plants in each strain.

NUMBER OF PLANTS WITH FOLLOWING LINT LENGTHS IN MM.

Strain.	57	58	59	60	61	62	*Mean.*
13	1		6	7	4	2	59·9
46			5	6	7	2	60·3

In these two strains all plants with low lint lengths (below 57 mm.) have been eliminated and the range in single plants is only slight—from 57-62 mm.

Since none of the eight strains with the highest bulk means showed on single plant analysis any plant of lint length less than 57 mm., it was decided to propagate a mixture of these eight for immediate replacement of the mixed commercial type. Examination of 150 plants selected at random from the propagation plot again gave no plant of mean less than 57 mm., and the mean of the 150 plants was 59·2 mm.

Thus practical purity was attained in one year's work, though much remained to be done in improving the habit of the plants. The old V135 was reputed to be a shy bearer, but the re-selected strain liberated for planting in 1933 has the following characters:

Mean Maximum Lint Length (Mm.).	*Weight of Seed Cotton per Boll (Gm.).*	*Weight of Lint per Boll (Gm.).*	*Lint Index.*	*Ginning (Per Cent.).*
58·7	3·06	0·71	38	23·2

The lint index and ginning percentage are very low. This is because selection for high lint index results in the lint becoming shorter and coarser. Nevertheless in 1932 a yield of 405 lbs. of lint per acre was obtained on one estate on an eight-acre block. This high yield is to be attributed to the good agricultural properties of the strain—viz., resistance to Angular Spot, and high number of bolls per plant.

Preservation of Pure Lines.—By self-fertilization over a number of years a strain can be obtained in a relatively pure condition. It is doubtful whether an absolutely pure line could ever be obtained in New World cottons, since it has been shown elsewhere that the Montserrat strains still responded to selection after seventeen years of selfing. As in Antirrhinum, mutation in modifying genes is doubtless rather frequent. Nevertheless a strain can be said to be pure from the commercial point of view after three or more generations of selfing. If the variety is fairly homogeneous to begin with, three generations of selfing may be enough. In most cotton-growing countries the main

difficulty of the cotton breeder is to preserve the purity of the strain, since natural crossing soon renders it heterogeneous. The obvious method of preserving purity from a genetical standpoint is to " tag " the pure strain with a particular combination of recessives, so that natural crosses can easily be distinguished. If, for instance, an Egyptian strain had cream pollen and no petal spot, any natural crosses with other Egyptians would have yellow pollen and petal spot, since these characters are universally found in Egyptian. If in subsequent generations all plants with these two characters were rigidly eliminated, the purity of the strain would be largely preserved. If, however, a natural cross produced seed, the resulting offspring would give 9 yellow pollen spotted, 3 yellow pollen spotless, 3 cream pollen spotted, and 1 cream pollen spotless. Thus one plant out of 15 would have the same genetic combination as the pure strain, and slow deterioration would result. Tagging the strain with 4 recessives would give only one plant out of 256 like the pure line in the second generation of a natural hybrid, and deterioration would then be extremely slow.

At present the rate of deterioration of a pure strain under conditions where a natural cross cannot be distinguished is rapid. It is not easy to find four good recessives to use for " tagging " Egyptian. Cream pollen is excellent as a first gene. Cream corolla could be used, but there is some evidence that the same gene which converts yellow corolla to cream also shortens and coarsens the lint. Recessive naked seed cannot be employed, since the lint index is about 25 per cent. less. Laciniated leaf reduces the yield of the plant, and the yielding power of " short branch " compared with normal is not known.

There is one obviously good gene found in a native West Indian tree cotton of Peruvian type (*G. barbadense* L.)—the gene conditioning red plant body and spotless or weakly spotted corolla. A cross between Sea Island (or Egyptian) and Red Spotless gives the following results:

	Sea Island.		*Red Tree Cotton.*
	Green plant body Strong petal spot	×	Red Plant body. Weak petal spot.
F_1—	Red plant body. Strong petal spot.		
F_2—	1 Red plant body. Weak petal spot.	2 Red plant body. Strong petal spot.	1 Green plant body. Strong petal spot.

The combination Red plant body–strong petal spot always segregates, and it is thus easy to eliminate natural crosses with green-spotted from the field. Similarly, natural crosses in a green strain can be easily detected by the plant body.

The problem before us was whether the red gene could be transferred

to Sea Island Superfine without any effect on the lint or agricultural properties. The answer to this question is in the affirmative. After four back crosses the resulting type possesses the red plant body and weak spot, and is otherwise indistinguishable from pure Sea Island. Moreover certain selections out of the second back cross showed almost complete immunity to angular leaf spot, together with some resistance to aphis. If yield and spinning tests prove satisfactory, it is planned to replace the present type with this new synthesized red.

The Improvement of Perennial Cotton.—A cotton-growing industry based on a perennial type has existed for at least 200 years in the Grenadines—a group of small islands between St. Vincent and Grenada. About 5,000 acres are at present under cultivation. The tree cottons grown belong to two different species—viz., *G. barbadense* L. (Peruvian type) and *G. purpurascens* Poir (Bourbon type).

The Peruvian type usually has short and coarse lint, and is susceptible to Leaf Blister mite (*Eriophyes gossypii*, Banks). The Bourbon type is known locally as Silk Cotton, and has a longer and silkier staple. The Peruvian type is genetically allied to Sea Island and Egyptian, while the Bourbon type has Upland affinities.

It had been known for many years that the Marie Galante cottons were very mixed, and some sporadic attempts were made at selection. Burd in 1922 made selections in Union Island of 250 types; these varied in lint length from 22 to 50 mm. He continued the selection work till 1926, after which Mr. T. Jackson, Agricultural Superintendent, took over the experiments. On examining the strains in 1930, it was found that single plants varied in lint length from 33 to 46 mm. By continuous selection we now have a strain breeding true to a lint length of 50 mm. It is, however, not very good as regards its agricultural properties, and it is being kept for crossing purposes.

In 1930 the writer made an extensive survey of the Serido district of the State of Rio Grande do Norte in North Brazil, where there is a large cotton-growing industry based on a Bourbon cotton known as Moco. The characters of this cotton are closely similar to the Grenadines Bourbon, but the lint is longer and finer. It therefore seemed that the introduction of Moco to the Grenadines might be of considerable economic advantage, since a higher price would be obtained for the product with no change in methods of cultivation. Selections within the Moco type with a view to purification have been made since 1930, and although the work was a good deal more difficult than that performed with Sea Island, there are now available some relatively pure strains with lint length of about 47 mm.

Samples of Moco were pronounced by the Fine Spinners and

Doublers Association in 1932 to be of similar length and fineness to Sakel Egyptian, but much weaker. Whether the weakness is due to the excessive rainfall and humidity in St. Vincent cannot yet be said, but the defect can probably be overcome by selection.

Selection work was initiated in Carriacou in 1931 by Mr. F. Simmons, Agricultural Instructor. He found a superior plant of the Bourbon type, and had a number of descendant lines from it in February, 1933, when the writer paid a visit to Carriacou. Many of the strains were extremely heterozygous, but purification based on the bulk sample technique was started, and the type is now commercially pure. A scheme has been put forward to replace the whole 5,000 acres of Marie Galante by the new type. It should be noted that selection has produced a new type of cotton of quality rather superior to Egyptian Sakel, but on a plant body of the species *G. purpurascens*.

In 1932 the valuation of the selected Carriacou type was 8·70d. (250 on American July futures at 6·20d.). In 1933 the valuation of the re-selections was 9d. to 10d. based on Fully fairly good Sakel at 8·51d. per lb.

It will be seen that by selection we have carried the Bourbon type right out of its former grade and created a new commercial type in between Egyptian and Sea Island. The yield of the new type is also exceedingly good, as the boll weight is considerably greater than that of the unselected type.

Work on African (U4) Cottons.—The writer paid a visit to the Corporation's Stations in South Africa in 1930. As a result of this visit it was decided to attempt to increase by crossing the possibilities for selection of Parnell's jassid resistant U4 type. It was considered that, by crossing U4 with certain other types known to possess either resistance to jassids or great powers of resistance to unfavourable conditions, useful material would result which could be used in different parts of Africa as a basis for selection. The genetical considerations involved in the proposed experiments were as follows:

We know that practically all characters of economic importance depend for their expression on complexes of a large number of genes in which individual genes probably play very little part. A cross of U4 by, say, a native tree cotton from the West Indies back crossed with U4 would contain on the average 75 per cent. of U4 genes, including the genes for jassid resistance. The plants would also contain 25 per cent. of the genes of the other parent, and combinations of these with the predominant U4 genes should give types of greater plasticity, and probably of great selective value.

Accordingly six different combinations were made up as follows:

(*a*) (Cambodia × Jamaica Xerophytic) × U4.
(*b*) (U4 × Jamaica Xerophytic) × U4.
(*c*) (U4 × Cambodia) × U4.
(*d*) (U4 × Gambia 14) × U4.
(*e*) (U4 × Gambia 14) × Cambodia.
(*f*) (Cambodia × Galapagos) × U4.

All the above strains have two doses of the jassid-resistant types U4 or Cambodia. The material from the back crosses was self-fertilized twice, and material from more than 1,200 selfed plants has been distributed for trial to eight African Stations. It is too early to state what the results of this experiment will be, but Mr. Parnell of the Barberton Station, commenting on the behaviour of an advance batch of material, states: "Some of these lots showed considerable promise, being tough and cropping well, though they were generally on the late side. They were not severely tested by jassid, but most of them showed definite resistance."

Work on Ishan Cotton.—Ishan cotton is grown in Nigeria. It is a variety of *G. barbadense* closely allied to Sea Island, Egyptian, and the Tanguis cotton of Peru. The mean maximum lint length was found to be 39 mm., and the quality rather coarse. In order to co-operate with the Nigerian workers on the improvement of the length and fineness of this type, it was resolved to attempt to incorporate genes for long lint from Sea Island by repeatedly back crossing heterozygous long-linted types to Ishan, and subsequently selfing. It is estimated that three generations of back crossing will be necessary before the final extraction by selfing. The F_1 and first back cross have been grown, and material is available for the second back cross in the forthcoming season.

Future Work.—As will be seen from the above, the main work of the Station during the past three years has been concerned with the purification and improvement of the two main cottons of the Colony—viz., Sea Island and perennial Marie Galante. It is necessary to continue and extend this work, but an increasing amount of attention will be given to the synthesis of entirely new types of cotton by the incorporation of characters from wild species. It has been known for a long time that the cultivated Asiatic cottons possessed a degree of resistance to adverse conditions not possessed by the cultivated types of the New World, and naturally cotton breeders have discussed the possibility of transferring Asiatic characters to New World cottons. For more than half a century it was thought impossible

even to hybridize the two species, but Zaitzev, working in Turkestan (1924), showed that it was possible to hybridize the Asiatic *G. herbaceum* with the New World *G. hirsutum* (Upland). The hybrid was, however, completely sterile. Meanwhile the writer had been making attempts to obtain hybrids from 1923 onwards. After several thousand crosses had been made, a hybrid was obtained in 1929 between a Sea Island–Egyptian F_1 and a red-flowered *G. arboreum*. This, contrary to the experience of previous workers, proved to be partly fertile on the male side, and back crosses were immediately made to New World types. With each successive back cross the fertility rose, until we now have a new type of U4 in which the flowers have bright red edges—due to the manifestation of the Asiatic red gene which had been carried over. This cotton is perfectly fertile and shows no trace of abnormality in the reduction division.

Now if it is possible to transfer one Asiatic gene from Old to New World cotton it is possible to transfer others, and even whole chromosomes or sections of chromosomes. The way is thus opened up to the production of a whole series of new cottons, some of which may make cotton-growing possible in areas where, owing to insect pests, it is now impracticable to do so.

Other wild species, such as *G. aridum* (formerly *Erioxylum aridum*) and *G. harknessii*, both New World species with only thirteen pairs of chromosomes, will also be made use of, since it has been shown by Dr. Skovsted of the Trinidad Station that partially fertile hybrids with New World cottons can easily be effected.

Received August, 1934.

SILAGE MAKING IN MUD-WALLED TOWERS

BY

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In the rain-fed areas of India and other places where rainfall is restricted to one season, natural green succulent fodder is available only for a part of the year. Dry, fibrous grass, or cereal crop residues, poor in feeding value and often deficient in essential minerals, are usually the only rations for livestock through the rest of the season. (Table I.)

With such periodic disturbances in the level of nutrition it is no wonder that the work-cattle are usually low in vitality, and particularly so at the onset of the rains, when the heaviest and most urgent work is to be done. Intensive cultivation without efficient bullock power is impossible, and a steady supply of succulent fodder during the dry season must be ensured.

All the main food and cash crops being dependent on the short and uncertain rainy season, the local cultivator is averse to growing crops merely for fodder. Green grass, however, is abundant during the rains, and at least one cutting is then possible without detriment to the subsequent hay harvest. To use this grass for pit silage is impossible, because at this time pits are full of water. Stack silage is also ruled out because of excessive drying-out in the hot season. The problem has been solved at Indore by using low circular " towers " made with mud walls such as the Indian cultivator uses for his house and other buildings. These towers have been used for three years, and enable the cultivator to preserve as silage any surplus grass, either alone or reinforced with a leguminous cover crop grown on the usual fallow before wheat.

A very similar fodder problem in Tanganyika has been described by Wakefield in the April issue of this Review, and a description of the Indore silage method may prove a useful contribution to the mixed farming programme now being advocated in such regions.

Making the Silo.—The silo consists of a mud tower 4 feet high and 10 feet or more in diameter, with walls 2 feet thick at the base tapered to 1 foot 6 inches thick at the top. A smaller diameter leads

FIG. 1. SILO READY FOR CHARGING.

FIG. 2.—COVERING THE SILO.

to inefficient packing. It is built of a puddled mixture of local soil and chaffed dry grass or straw, the proportion of straw to earth varying from 4 to 8 lbs. per cubic foot of earth, and depending upon the liability of the earth to shrink and crack on drying. To allow for setting not more than 1 foot height should be built in a day. When the tower is complete the wall is plastered inside and out with a fairly thick plaster of cattle dung. After not less than four days it is plastered a second time. A small outlet is provided at the bottom of the wall to prevent rain water accumulating inside when empty; this is carefully closed after the silo is charged.

Such a silo (Fig. 1) lasts for several seasons with slight repairs. The gradual building of the silo can always be done by the cultivator's family during off periods and even during the rains. Usually the peasant and his wife can prepare the mud and build one silo of this size in ninety-six hours. About 250 cubic feet of earth are sufficient.

Charging.—Grass just about to flower is most suitable, and edible weeds can be mixed with advantage. A mixture of coarse with fine materials, such as coarse sorghums or maize with ordinary grass or thin-stemmed edible weeds, packs better than any single material. One part of a leguminous cover crop like cowpea or beans to four parts or more of grass or cereals makes a richer silage. Chaffing is quite unnecessary. Thick and long stems of sorghums or maize require cutting into two or three shorter lengths. The material is thrown in evenly all round the silo, butts and tops alternating, and packed by trampling.

Better packing is ensured by intermittent filling—about a foot a day—due to natural shrinkage of the withering material. The charge is finished by stacking the material into a dome 6 inches above the wall at the periphery, and 18 inches to 2 feet at the centre.

Closing the Silo and Maintenance.—A 6-inch covering layer of chaffed straw or similar material, thoroughly wetted, is then added, followed by a foot of mixed mud and chaff thrown on top in lumps to ensure compactness. The top surface is then smoothed by hand and plastered with cattle dung (Fig. 2). The plastering may have to be repeated several times at intervals if cracks appear. The silo can then be left alone until required. Cracks should never be allowed to remain unstopped, otherwise the silage will decay; if the silo cracks badly the whole of the contents may be spoilt. When fodder is needed the top is opened on one side and the material gradually removed.

Quantities.—One such silo holds about 4 tons of fresh material, finally yielding from 2·8 to 3·6 tons of edible silage. A portion of the material is always spoilt, the quantity depending upon the

efficiency of packing conditions and tight sealing of the tower. It appears that the absolute loss of material as gas is proportional to the amount of material spoilt, and is, therefore, an indication of the extent of wasteful fermentation. (Table II.)

Not more than two such towers will be required for one pair of oxen for eight dry months when fed at 20 lbs. per animal per day. This is the rate used at Indore, and it has kept the farm stock in good condition all the year round since the inception of the Institute in 1924.

Table III. gives the composition of silage made from different materials.

SUMMARY.

A silage tower is described which costs no money, and can be built by entirely unskilled cultivators. Most agricultural peoples build mud houses or mud storage bins, and there should be no difficulty in persuading them to build mud towers for the storage of silage.

The method appears to be of general application where labour is cheap, the only further work required being the building of experimental towers in various places to determine the right proportion of straw to earth of different types to prevent cracking. Some practice will be necessary to secure the most efficient packing of the materials available.

ACKNOWLEDGMENTS.

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TABLE I.—COMPOSITION OF *ANDROPOGON CONTORTUS* AT DIFFERENT STAGES OF GROWTH.*

	Per Cent. Moisture (on Fresh Material).	*Per Cent. on Oven-dry Basis.†*				
		Ether Extract.	*Albuminoids.*	*Digestible Carbohydrate.*	*Woody Fibre.*	*Ash.*
Before flowering	66·2	5·0	7·1	67·2	11·9	8·9
At flowering	62·0	4·2	6·3	58·4	15·0	16·1
Dry grass ...	6·9	1·3	2·3	53·9	34·6	8·0

TABLE II.—RELATION OF WASTAGE TO TOWER DIAMETER.

Diameter of the tower.	*Material Used.*	*Lbs.*		*Per Cent. Silage, Good and Spoilt.*			
		Material Filled.	*Final Silage.*	*Total Silage.*	*Edible.*	*Spoilt.*	*Loss in Weight.*
10ft. 6ins.	Grass and Green Sorghum	11,230	10,200	99·7	94·4	5·3	0·3
6 ft.	Sorghum alone ...	1,889	1,424	75·4	38·8	35·6	25·6
6 ft.	Sorghum and *Gavala* (leguminous weed)	2,827	2,711	95·5	Nil	95·5	4·5

TABLE III.—COMPOSITION OF SILAGE MADE IN MUD TOWERS AT INDORE.

Material Used (Uncut).	*Per Cent. on Fresh.*		*Per Cent. on Oven-dry.*								
							Ash.				
	Moisture.	*Acidity.*	*Total Nitrogen.*	*Crude Proteins.*	*Albuminoid Nitrogen.*	*Albuminoids.*	*Insoluble.*	*Soluble.*	*Ether Extract.*	*Crude Fibre.*	*Digestible Carbohyd.*
Sorghum stalks	72·35	13·94	1·15	7·17	0·78	4·86	4·45	3·12	4·66	39·90	39·28
Grass ..	29·00	9·40	0·71	4·44	0·36	2·25	4·05	2·21	3·30	35·95	49·59
Sorghum + Cowpea	66·30	9·50	0·80	5·00	0·56	3·50	6·21	2·33	3·00	38·35	45·11
Grass + Soy Beans 2:1	69·78	10·70	0·75	4·78	0·34	2·09	7·26	2·01	5·24	37·90	42·85
Grass + Soy Beans 4:1	72·81	11·65	1·17	7·46	0·64	3·98	6·86	3·28	4·36	39·00	38·21

* *Memoirs Dept. Agr. Ind.*, Botanical Series, Vol. XIV., 1925-27, p. 43.
† Calculated on oven-dry basis from the original.

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COTTON STATISTICS

BY

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DEVELOPMENTS in the cotton world since our last issue have centred almost entirely in the surprising fortunes or misfortunes of the American crop. That is, of course, to a certain extent normal at this stage of the season, but this year the developments have been entirely abnormal, as the result not only of Government action, but also of the vagaries of nature.

Reference was made in our last issue to the Bankhead Bill, the object of which was to supplement the acreage restriction under the Leasing Plan of last autumn by restricting the amount of the crop to be ginned this year (except under a prohibitive penalty) to 10,000,000 bales of 500 lbs. net, but this is equivalent to 10,460,000 of the usual statistical unit, which is 500 lbs. gross and 478 net. Ten millions was, of course, regarded as a minimum. About the end of May, however, reports from America indicating a severe drought in the Wheat Belt suggested the possibility of similar developments in cotton. On July 8 the acreage figures were published and proved to be much less than expected. In June and July the drought in the Western Belt developed to a very serious extent, with the result that the first Bureau Report on August 8 indicated a probable yield of only 9,195,000 bales. On September 8, however, the figure was raised to 9,252,000.

The possibility of so small an American crop inevitably gave additional importance to the position of consumption and carry-over. Garside's estimates of the World Consumption both of American and Outside Growths are therefore given in the table on page 319, with the Federation figures for comparison. The net result of Garside's figures is that the world's consumption of American has been seriously reduced in the second half of the season, the reduction being shown in every one of the major divisions. In consequence of this the season's total is about 850,000 bales less than last season. In Outside Growths, however, the consumption during the second half of the season has continued the increase which had been shown in the first half of the season, with the result that the season's total has

increased by about 1,300,000 bales. This continued swing-over from American to Outside Growths is the inevitable result of the forced raising of the price of American, and judging by present indications it will continue to be the feature of the coming season.

The half-yearly figures, however, do not give the whole story as regards consumption. The heaviest decline was in America itself. As will be seen from the table of the U.S. Monthly Consumption on page 319 their figures held up pretty well till April, and even the May figure was good except by comparison with the very high figure of May, 1933. But in June the American industry adopted a 25 per cent. restriction for three months, and the result was shown in a very heavy fall of the consumption in June and July.

To complete the supply position, however, it is necessary to consider the World's Carry-over of American cotton, the figures of which are given in the table on page 318. Here again up till the end of May the usual seasonal reduction of the carry-over was proceeding at a full average rate, but the decline was checked in June, and the final result as at July 31 was a world figure of 10,522,000 bales as against 11,550,000 bales a year ago. Thus for the second year in succession the World's Carry-over of American cotton has been reduced by about a million bales, but the important fact is that the total is still large enough, even with a crop of only 9,000,000 bales, to prevent any possibility of actual scarcity during the coming season.

The effect of all this on prices is seen in the tables on page 320. As the result of the threat to the American crop, prices marked new high levels (since June, 1930) in July, and the confirmation of these fears by the August report produced a still further rise in August, which, however, was not maintained throughout the month owing to the partial breaking of the drought.

But as American rose the prices of other varieties lagged behind, as is shown by the table of Liverpool Spot Prices of American with other varieties as percentages. Most of these had already fallen to new low levels at the end of July, and this movement was continued still further in August.

The position of Egyptian was complicated by the different relative movements of Sakel and Uppers. Uppers has on the whole followed American fairly well throughout the season, but with a declining tendency as the result of the very large crop of Uppers, details of which will be found in the table on page 317. But the movements of Sakel during the season were very irregular. After the very low point in October, which was largely the result of a speculative position in Liverpool, Sakel rose again to a new high point in February; but

since then it has been sagging very severely, so that, unlike American and Uppers, it failed to reach a new high point in July. This was all the more noticeable in view of the developments with regard to the Egyptian acreage for the coming season. It was generally expected that in view of the complete withdrawal of restrictions the Egyptian acreage would be at least 2,000,000 feddans, and would even mark a new record above that of 2,082,000 feddans in 1930. When the acreage figures were published, however, it appeared that only Sakel and Giza 7 showed any material increase, while other varieties showed a definite decline, so that the total was actually 4 per cent. less than last year (1,732,000 feddans against 1,804,000).

The table of the Indian crop on page 318 gives the final details for 1933-34, but complete information is not yet available as regards 1934-35. The first forecast in August only covers 60 per cent. of the whole area, but for what it is worth it may be noted that it showed an unexpected decrease of the acreage in these areas from 13,999,000 to 12,985,000, or 7·2 per cent.

AMERICAN CROP (EXCLUDING LINTERS).

	1928–29.	1929–30.	1930–31.	1931–32.	1932–33.	1933–34.
Acreage planted (000's)	43,735	44,458	43,339	39,109	36,542	40,852*
Acreage harvested ...	42,432	43,242	42,454	38,705	35,939	29,978
Crop (running bales)...	14,297	14,548	13,756	16,629	12,710	12,664
Yield per acre (lbs.) ...	163·3	164·1	157·0	211·5	173·3	208·5
Season's average spot price (Liverpool—pence per lb.) ...	10·52	9·09	5·71	4·82	5·62	

PROGRESS OF THE SEASON 1934–35.

	August.	*Sept.*	*Oct.*	*Nov.*	*Dec.*	*March.*
Acreage planted ...	28,024	28,024				
Acreage harvested ...	27,371	27,241				
Crop (500 lb. bales) ...	9,195	9,252				
Yield per acre (lbs.)...	160·9	162·6				

* Less 10,396,000 acres special abandonment.

EGYPTIAN AREA AND CROP BY VARIETIES.

(THE CROP ESTIMATES EXCLUDE SCARTO.) 000'S OMITTED.

	1932.			1933.			1934.
	Area: Feddans	*Crop: Kantars*	*Average Yield*	*Area: Feddans*	*Crop: Kantars*	*Average Yield*	*Area: Feddans*
Long Staple:							
Sakel	369	1,216	3·29	391	1,153	2·95	420
Maarad	70	287	4·12	110	377	3·44	54
Giza 7	35	163	4·64	124	440	3·54	287
Sakha 4	18	63	3·52	46	149	3·21	10
Casouli	2	12	7·74*	3	13	4·06	3
Group Total	494	1,741	3·53	675	2,132	3·16	774
Per Cent. of Total ..	*45·1*	—	—	*37·4*	—	—	*44·7*
Medium:							
Nahda	29	131	4·45	27	93	3·44	10
Fouadi	17	49	2·90	49	101	2·05	39
Pilion	39	161	4·12	31	158	5·04	8
Giza 3	7	12	1·78*	7	12	1·82*	10
Group Total	92	352	3·84	114	365	3·19	67
Per Cent. of Total ..	*8·4*	—	—	*6,3*	—	—	*3·9*
Short:							
Ashmouni and Zagora ..	507	2,740	5·40	1,010	5,881	5·82	885
Others	1	14	10·56*	5	33	6·84*	6
Group Total	508	2,754	5·42	1,015	5,914	5·83	891
Per Cent. of Total ..	*46·5*	—	—	*56·3*	—	—	*51·4*
Total	1,094	4,848	4·43	1,804	8,411	4·66	1,732
Per Cent. Change in Acreage	*–35·0*	—	—	*+64·9*	—	—	*–4·0*
Lower Egypt	792	—	—	1,240	—	—	1,175
Upper Egypt . ..	301	—	—	565	—	—	557
Per Cent. of Total ..	*27·6*	—	—	*31·3*	—	—	*32·2*

These figures seem to require correction.

INDIAN CROP.

(000's *Omitted.*)

	1928–9.	1929–30.	1930–31.	1931–32.	1932–33.	1933–34.
Area (acres)	27,053	25,922	23,812	23,722	22,483	23,739
Crop (Government estimate) 400-lb. bales	5,782	5,243	5,226	4,007	4,656	4,970
Average yield per acre (lbs.)	85	81	88	68	83	84
Staple $\frac{7}{8}$ and above (bales)	2,190	1,807	1,795	1,734	1,795	1,922
Per Cent. of Total ...	*37·9*	*34·5*	*34·4*	*43·1*	*38·6*	*38·7*
Staple below $\frac{7}{8}$ (bales) ...	3,592	3,436	3,429	2,291	2,861	3,048
Per Cent. of Total ...	*62·1*	*65·5*	*65·6*	*56·9*	*61·4*	*61·3*
Commercial Crop :						
Nett exports (bales) ...	3,933	3,868	3,729	1,582	2,741	—
Mill consumption ...	1,992	2,373	2,271	2,346	2,360	—
Domestic consumption ...	750	750	750	750	750	—
Total	6,675	6,991	6,750	4,678	5,851	—
Per cent. on Government estimate	+15·4	+33·3	+29·2	+16·7	+25·7	—
Season's average spot price (Liverpool—pence per lb.)	8·03	6·39	4·02	4·32	4·84	4·52
Per cent. on American ...	76·3	70·3	70·4	89·6	86·1	75·1

WORLD'S CARRY-OVER OF *AMERICAN* COTTON.

(Running Bales 000's, excluding Linters in U.S.A.)

End of	*Stock and Afloat.*			*U.S.A.*		*Monthly Totals.*	*Federation. Other Mill Stocks.*	*Half-Yearly Totals.*	*Elsewhere in U.S.A.**
	U.K.	*Continent.*	*Orient.*	*Mill Stocks.*	*Public Warehouses.*				
1929, July ...	442	563	—	932	923	2,860	1,197	4,332	275
1930, January ...	618	1,198	448	1,730	5,343	9,337	1,007	10,344	—
July ...	304	544	143	1,048	2,803	4,842	937	6,249	470
1931, January ...	644	1,198	343	1,523	7,895	11,603	907	12,510	—
July ...	436	766	401	922	4,491	7,016	950	8,816	850
1932, January ...	506	938	805	1,583	10,019	13,851	1,193	15,044	—
July ...	415	729	695	1,163	6,657	9,659	1,379	12,798	1,760
1933, January ...	620	1,189	852	1,455	9,982	14,098	1,248	15,346	—
July ...	536	1,058	616	1,298	5,703	9,211	1,259	11,550	1,080
August ...	542	957	555	1,113	5,764	8,931	—	—	—
September	554	1,056	604	1,115	7,347	10,676	—	—	—
October ...	549	1,224	701	1,315	9,452	13,241	—	—	—
November	593	1,340	818	1,526	10,387	14,664	—	—	—
December	648	1,364	776	1,596	10,288	14,672	—	—	—
1934, January ...	617	1,367	752	1,553	9,474	13,763	1,320	15,083	
February	614	1,325	730	1,605	8,609	12,883			
March ...	588	1,217	686	1,600	7,819	16,908			
April ...	559	1,098	611	1,533	7,064	10,865			
May ...	491	940	584	1,366	6,529	9,919			
June ...	432	841	663	1,272	5,944	9,152			
July ...	405	734	590	1,176	5,523	8,428	1,144	10,522	950
August ...	370	649	545						

* Included in total.

WORLD'S CONSUMPTION OF COTTON.

FROM THE STATISTICS OF THE NEW YORK COTTON EXCHANGE SERVICE (GARSIDE).
(*Running Bales 000's—Outside Growths in 500-lb. Bales.*)

1932–33.	*American.*						*Outside Growths.*	*All Kinds.*
	U.S.A.	*U.K.*	*Continent.*	*Orient.*	*Others.*	*Total.*		
1st Half Season	2,749	666	1,989	1,466	106	6,977	5,028	12,005
,, *Federation* ...	*2,749*	*665*	*1,862*	*1,445*	*126*	*6,847*	*5,035*	*11,882*
2nd Half Season	3,255	699	2,090	1,255	130	7,428	5,207	12,635
,, *Federation* ...	*3,255*	*735*	*1,974*	*1,210*	*150*	*7,324*	*5,147*	*12,471*
Season's Total	6,004	1,365	4,079	2,721	236	14,405	10,235	24,640
1933–34.*								
1st Half Season	2,847	765	2,160	1,172	144	7,088	5,655	12,743
,, *Federation* ...	*2,847*	*771*	*2,086*	*1,148*	*166*	*7,018*	*5,501*	*12,519*
2nd Half Season	2,704	641	2,013	991	127	6,476	5,887	12,363
,, *Federation* ...	*2,707*	*690*	*1,897*	*1,090*	*133*	*6,517*	*6,043*	*12,560*
Season's Total	5,551	1,406	4,173	2,163	271	13,564	11,542	25,106

* Subject to revision.

U.S. CONSUMPTION OF COTTON BY VARIETIES.

(RUNNING BALES 000'S: "FOREIGN" IN EQUIVALENT 500-LB. BALES.)

1932–33.	*Total.*	*Daily Rate.*	*Upland.*	*American Egyptian.*	*Egyptian.*	*Other Foreign.*	*Linters not Included.*
February ...	441·7	20·3	432·2	1·9	6·3	2·1	46·5
March ...	494·2	19·8	482·6	2·0	7·2	3·2	50·1
April ...	470·7	21·2	460·0	1·2	6·2	3·3	54·7
May ...	620·9	25·1	606·5	1·1	9·3	4·0	76·1
June ...	696·5	29·0	681·0	1·6	9·0	4·9	81·5
July ...	600·1	26·7	583·9	1·5	9·7	5·1	90·5
1933–34.							
August ...	588·6	25·6	571·3	1·2	11·3	4·8	83·3
September ...	499·5	24·1	485·7	0·9	9·2	3·8	76·5
October ...	503·9	23·2	489·0	1·1	9·6	4·2	66·8
November ...	475·4	22·1	461·8	0·9	9·0	3·6	59·1
December ...	348·4	19·4	338·9	1·1	6·2	2·2	51·6
January ...	508·0	22·3	493·8	1·1	10·2	2·9	57·8
February ...	477·9	24·2	463·8	1·5	9·3	3·3	59·7
March ...	543·7	24·7	527·9	1·3	10·7	3·8	74·5
April ...	512·7	24·4	499·1	1·1	8·6	4·0	67·8
May ...	519·8	22·8	507·1	1·0	7·4	4·3	63·9
June ...	363·4	17·3	352·9	1·0	6·3	3·2	55·0
July ...	359·4						
1934–35.							
August ...							

HIGHEST AND LOWEST FUTURES PRICES.

1932–33.	*American.*				*Egyptian (Liverpool).*			
	New York.		*Liverpool.*		*Sakel.*		*Uppers.*	
	High.	*Low.*	*High.*	*Low.*	*High.*	*Low.*	*High.*	*Low.*
February	6·30	5·85	4·89	4·61	7·08	6·67	6·38	6·01
March ...	6·97	5·93	5·17	4·50	7·16	*6·45*	6·39	*5·80*
April ...	7·90	6·41	5·31	4·82	7·28	6·84	6·53	6·02
May ...	9·42	8·03	6·19	5·37	8·28	7·24	7·34	6·55
June ...	10·75	9·10	6·39	5·81	8·37	7·95	7·37	6·97
July ...	*12·00*	9·58	6·34	5·75	8·31	7·86	7·44	6·95
1933–34.								
August ...	10·66	*8·47*	6·12	5·22	8·02	7·00	7·21	6·33
September	10·71	8·94	5·58	5·15	7·34	6·84	6·46	6·01
October ...	10·08	8·83	5·47	5·15	7·21	6·79	6·26	5·91
November	10·30	9·41	5·29	*4·78*	7·08	*6·52*	5·99	*5·44*
December	10·29	9·96	5·20	4·96	7·55	6·78	5·99	5·67
January ...	11·49	10·30	5·93	5·19	8·42	7·57	6·58	5·99
February	12·54	11·53	6·48	5·92	*9·25*	8·36	7·23	6·61
March ...	12·38	11·71	6·40	6·04	8·91	8·35	6·99	6·69
April ...	12·23	10·86	6·14	5·62	8·62	7·90	6·80	6·18
May ...	11·59	10·70	6·05	5·57	8·37	7·88	6·63	6·14
June ...	12·52	11·61	6·55	5·94	8·48	8·22	6·98	6·55
July ...	*13·35*	12·03	*6·97*	6·28	8·60	8·10	*7·31*	6·75
1934–35								
August ...	13·84	12·97	7·23	6·77	8·71	8·29	7·54	7·19

Maximum and minimum figures in each season are given in italics.

LIVERPOOL SPOT PRICES OF AMERICAN WITH OTHER VARIETIES AS PERCENTAGES (LAST FRIDAY OF EACH MONTH).

1932–33.	*American (Middling). Pence per Lb.*	*Indian No. 1 Fine Oomra.*	*West African (Middling).*	*Brazil Pernam (Fair).*	*East African (Good Fair).*	*Tanguis (Good).*	*Uppers (F.G.F.).*	*Sakel (F.G.F.).*
February	4·95	89·5	101·0	103·0	119·2	126·3	129·5	141·8
March ...	5·15	80·0	100·0	101·9	117·5	126·2	124·3	137·9
April ...	5·53	80·7	100·0	101·8	119·9	124·4	121·2	134·7
May ...	6·07	80·1	100·0	101·6	114·8	122·2	120·4	134·6
June ...	6·38	80·6	100·0	101·6	114·1	121·2	116·9	131·2
July ...	6·47	81·0	101·5	101·5	113·9	120·9	118·7	131·1
Season's average	*5·62*	*86·1*	*100·7*	*102·0*	*117·4*	*124·2*	*124·7*	*138·6*
1933–34.								
August ...	5·53	79·6	101·3	103·1	115·7	124·8	122·4	136·0
September	5·60	80·7	100·9	103·6	114·3	124·1	114·6	132·0
October ...	5·54	78·3	100·0	102·7	113·5	122·6	111·0	127·4
November	5·09	77·6	100·0	102·9	114·7	120·6	112·6	137·7
December	5·33	75·6	100·0	100·9	114·1	124·4	113·5	145·2
January ...	6·07	74·0	99·2	99·2	111·5	120·6	109·9	140·4
February	6·67	73·2	98·5	97·8	107·5	118·0	107·9	136·6
March ...	6·35	70·1	98·4	94·5	107·9	118·9	108·0	137·6
April ...	5·88	70·9	100·0	94·9	109·4	121·3	106·5	137·2
May ...	6·20	75·2	99·2	95·2	108·9	120·2	107·6	135·8
June ...	6·84	73·2	99·3	95·6	107·3	118·3	102·8	122·1
July ...	6·97	72·5	98·6	96·4	106·5	117·2	104·0	122·0
Season's average	6·02	75·1	99·5	98·8	110·8	120·8	110·3	133·7
934–35.								
August ...	7·11	70·5	99.3	96·5	105·6	116·2	105·1	122·9

NOTES ON CURRENT LITERATURE

COTTON IN INDIA.

496. INDIAN COTTON INDUSTRY: PROTECTION. (*Ind. Text. J.*, **44**, 1934, p. 167. Abstr. from *J. of Text. Inst.*, xxv., **6**, 1934, A319.) A summary is given of the findings and recommendations of the Indian Tariff Board. The recommendations have been embodied with modifications in the Indian Tariff (Textile Protection) Amendment Bill.

497. ENCOURAGING INDIAN COTTON. (*Text. Weekly*, **327**, 1934, p. 384.) The Indian Central Cotton Committee are endeavouring by means of posters to encourage the natives to grow better strains of cotton. One poster, in the Kanarese vernacular, has been specially prepared to show the advantages of growing Jayawant cotton. A similar poster, entitled "It pays to grow cotton in Sind," has been issued to encourage cotton-growing on the right bank of the Indus.

498. REPORT ON THE STAPLE LENGTH OF THE INDIAN COTTON CROP OF 1933-34 SEASON. (*Stat. Leaflet No.* 1, 1933-34, Ind. Cent. Cott. Comm.) A new departure in Indian statistics. In view of the increased interest shown in the problem of marketing Indian cotton the Indian Central Cotton Committee have published this report to enable a clear idea to be obtained of India's contribution to the world's requirements of cotton of varying staple lengths. The crop of 1933-34 is estimated to produce in bales of 400 lbs.:

	Bales.
Long staple, over 1 inch	24,000
Medium staple, $\frac{7}{8}$ to 1 inch	1,395,000
Short staple, below $\frac{7}{8}$ inch	3,551,000
Grand total	4,970,000

499. INDIAN COTTON CHART, 1933-34. We have received from Messrs. Chunilal, Mehta and Company, Bombay, a copy of the cotton chart which has been published by them annually for the past ten years at the termination of the Broach contract for April-May delivery. The chart gives as usual April-May Broach quotations in Bombay and corresponding contract quotations for American cotton in Liverpool and New York. The London-New York cross-rate is again included since it continues to be an important factor. A new feature this year is the inclusion of ten years' statistics relating to Indian cotton acreage, crop estimate, and yield per acre.

500. LIST OF COTTON-PRESSING FACTORIES, WITH NAMES OF OWNERS AND PARTICULARS OF MARKS ALLOTTED TO THEM IN THE DIFFERENT PROVINCES OF BRITISH INDIA AND CERTAIN INDIAN STATES, FOR THE SEASON 1933-34. (Govt. of India Cent. Pub. Branch, Calcutta, 1934. Price R. 1-8, or 2s. 6d.)

501. INDIAN CENTRAL COTTON COMMITTEE. We have received from the Publicity Officer the following notices:

Cotton Research in the Punjab. Prejudice appears to have arisen against the use as a cattle feed of the seeds of the long staple cottons, 285F and 289F, on account of their fuzziness. There seems no good ground for this prejudice, and experiments have been undertaken to prove or disprove it.

Pempheres. Deals with the life-history of the cotton stem weevil, the injury caused to cotton, and methods of control suggested.

502. SPINNING TEST REPORTS ON INDIAN COTTONS. By N. Ahmad. (*Ind. Cent. Cott. Comm. Tech. Circs.*, Nos. 123-6; 131-4. 1933-34.) The circulars contain the grader's report and spinning-test results for Hubli Kumpta, Hubli Upland, Broach, Surat, Punjab-American, Westerns, Miraj, Tiruppur Cambodia, Farm Westerns, Kumpta, and Jagadia cottons for the 1933-34 season.

503. TECHNOLOGICAL REPORTS ON STANDARD INDIAN COTTONS. By N. Ahmad. (*Tech. Circs.*, Nos. 127-30; 135. 1933-34.) Copies have been received from the Indian Central Cotton Committee of reports on the cottons named below. The particulars include agricultural details, grader's report, fibre particulars, spinning tests, remarks and conclusions.

1. *Surat* 1027 *A.L.F.*—Area under cultivation 234,700 acres. The 1933-34 sample possessed the longest and finest staple and gave the strongest yarns. It is suitable for 37's warp.
2. *Hagari* 1.—The 1933-34 sample was suitable for 28's warp as compared with 21's warp in 1932-33.
3. *Cambodia Co.* 2 (*Cambodia* 440).—Area under cultivation 47,000 acres. The cotton is suitable for 26's warp.
4. *Gadag* 1 (*Dharwar-American*).—Yarns spun from this cotton are generally slightly neppy. The 1933-34 sample was suitable for 30's warp.
5. *Jayawant* (*Kumpta*).—Area under cultivation 138,140 acres. The yarns spun from this cotton are practically free from neps. The 1933-34 sample was suitable for 30's warp.

504. DOKRAS COTTON. By M. R. Dokras. (*Hitavada Press*, Nagpur, 3/5/34.) The origin of this cotton was a natural cross of Garroh Hills Bani selected by the author in 1929 for future multiplication. An account is given of the selection work carried out during the past five years; which has resulted in the present strain, "Dokras No. 11." A sample submitted to the Director of the Technological Research Laboratory, Bombay, is reported on as follows: "Dokras 11 is about 15 per cent. longer and finer than the Standard Verum 262 of 1933-34, grown either in Nagpur or Akola. It has the same mean fibre strength as Verum, but its intrinsic strength is much higher. It possesses very nearly the same mean fibre-length and mean fibre-weight per inch as last season's Bani grown in Nagpur. According to these fibre-properties, this Dokras cotton is much superior to Verum 262 cotton, and is adjudged suitable for spinning up to 33's standard warp counts."

505. JAYAWANT COTTON: PRODUCTION. (*Ind. Text. J.*, **44**, 1934, p. 176. Abstr. from *J. of Text. Inst.*, xxv., **6**, 1934, A274.) Jayawant cotton is an improved type of Kumpta. It was obtained by crossing two strains, one selected for yield, ginning percentage and staple, and the other for resistance to wilt. It is one of the best staple cottons of India, and can be spun to 34's. Seed distribution was started in 1930, and in the season 1933-34 the quantity of pure seed distributed for sowing was 1,363,403 lb., which covered an area of about 170,000 acres. Annually, on an average 50,000 bales of 400 lb. each are pressed in Hubli. Of these, 15,000 bales are of American types of cotton, and the remaining 35,000 bales are of Kumpta and Jayawant put together. A large increase in the proportion of Jayawant Kumpta (improved variety) is estimated for the coming season.

506. ANALYSIS OF ROTATIONAL EXPERIMENTS WITH COTTON, GROUNDNUT AND JUAR IN BERAR, WITH NOTES ON DESIGNS FOR ROTATIONAL EXPERIMENTS. By P. C. Mahalanobis. (*Ind. J. Agr. Sci.*, iv., **2**, 1934, p. 361.) The pooled results for different rotations indicated that the best yields were obtained when cotton succeeded groundnut, but not *juar*.

507. SOME NOTES ON PRACTICAL SILAGE MAKING. By W. S. Read. (*Agr. and Livestock in India,* iv., **3**, 1934, p. 231.) Describes the "silo-pit" method which is considered the most suitable method for Indian conditions.

508. MYSORE: *Cotton Cultivation,* 1933. (*Rpt. of Agr. Dpt. Mysore,* 1933, recently received.) Work on cotton has related to the raising of pure seed of selection 69 for the seed farms, and to the production of new types by careful hybridization. Two varieties were tested for wilt resistance and were found to be quite useful. For the study of Doddahatti cotton a small farm was opened in Singapur Kaval lands, and the comparative trials of the different strains were commenced during the year.

509. PUNJAB: POSITION OF COTTON. By Col. E. H. Cole. (*Seasonal Notes,* xii., **1**, 1934, p. 21. Punjab Agr. Dept.) Calling attention to the good prices obtainable in Bombay for the N.T. 36 strain of cotton grown in the Punjab.

COTTON IN THE EMPIRE (EXCLUDING INDIA).

510. The following reports have recently been received:

Imperial Institute: Ann. Rpt., 1933.

South-Eastern Agricultural College, Wye: "The Journal," July, 1934.

NORTHERN RHODESIA: Ann. Bull. Dept. of Agr., 1933.
  Ann. Rpt. Dpt. of Agr., 1933.

SUDAN: Ann. Rpt. of Dpt. of Agr. and Forests, 1933.
  Ann. Rpt. of Govt. Chemist, 1933.

511. IMPERIAL INSTITUTE. The Annual Report for 1933 has recently been issued, and illustrates the work carried out during the year by the various departments of the Institute. In the Plant and Animal Products Section 1305 enquiries were dealt with, and reports were furnished on 209 investigations. The number of samples received was 689. In the Mineral Resources Department 728 enquiries were dealt with, reports were made on 113 investigations, the number of samples examined being 443. There were 738,718 visitors to the Exhibition Galleries during the year, and no less than 2,963 organized parties from schools attended the conducted tours, lectures, etc. The number of visitors to the cinema displays was 146,000.

512. ASIA. CYPRUS: *Cotton Cultivation.* (*Ann. Rpt. Emp. Cott. Growg. Corpn.,* 1932-33, issued 1934.) "In 1932 the Agricultural Department carried out various experiments, including trials with imported varieties of cotton, with a view to deciding the best types for Cyprus conditions. Their experiments reached a stage last season at which they were in a position to send samples for spinning tests. The samples sent included an indigenous variety, a strain known as Titsiros, and imported varieties—Mesowhite, obtained originally from Iraq, and U.4, obtained from the Corporation's Plant Breeding Station at Barberton, South Africa. The tests showed that the two latter were greatly superior in spinning quality to the local varieties; whereas the indigenous variety was suitable for counts from 10's to 12's, and Titsiros for counts 16's to 18's, U.4 proved suitable for 54's to 56's, and Mesowhite for 58's to 60's. The Agricultural Department, in acknowledging these reports, stated that the results would be of considerable value to them.

"The actual area planted in Cyprus each year depends largely on the amount of irrigation water available for cotton in competition with other crops that are grown in larger quantities. In 1933 both irrigated and non-irrigated cotton suffered through the depleted irrigation water supplies and the lack of sufficient rain. The area was again reduced, and production was the lowest on record since the British Occupation. The prospects for 1934 are more hopeful; good rains have fallen in all areas, and it is anticipated that the normal acreage will be planted."

513. AFRICA. NYASALAND: *Cotton Cultivation*, 1932-33. (*Ann. Rpt. Emp. Cott. Growg. Corpn.*, 1932-33, issued 1934.) "The removal of the Corporation's principal cotton experiment station from Makwapala to Domira Bay, near the south-west corner of Lake Nyasa, has so far been attended with satisfactory results. About 150 acres are now under cultivation at the Station, and this provides for 60 acres of cotton annually for the experiments. The favourable opinion that has been formed as to the suitability for cotton of the land at this Station was confirmed by the fact that over the whole acreage the yield last season amounted to 250 lb. of lint per acre. These good yields have provided a stock of seed of improved U.4 types which will plant a multiplication area of at least 1,000 acres. This will be planted under controlled conditions by native growers in the Domira Bay area."

514. *Cotton Prospects.* A recent report received from H.M. East African Dependencies Trade and Information Office is to the effect "that in May and the early part of June slight checks in growth were caused by local droughts, aphis, and bollworm damage, and cold snaps associated with a later rain period, but that this phase has passed, and the prospects of a very good crop are excellent. Stainers are present but are causing little damage. Instruction is being given in good grading and in conserving the present soil moisture by mulching."

515. NYASALAND RAILWAY'S NORTHERN EXTENSION. (*Crown Colonist*, June, 1934, p. 283.) Work upon the construction of the northern extension of the Nyasaland Railway from Blantyre towards Lake Nyasa was so far completed in the early part of the year that it was anticipated that the 160 miles of line up to Salima, or to within about 10 miles of the lake, would be open for goods traffic by the end of April. The remaining earthwork onwards to Domira Bay has been completed, but track will not be laid upon it before 1935, as, for reasons of economy, it is proposed to use permanent way released by the completion of the Zambesi bridge for the last 10 miles into Domira Bay. Meanwhile it is expected that the railway formation will be used to carry road traffic from the lake to rail-head.

516. DENUDATION AND SOIL EROSION IN NYASALAND. By A. J. W. Hornby. (*Bull. No.* 11. [New Series.], Dept. of Agr., Nyasaland, 1934.) The subject is considered under the following heads: Comparative effects of denudation and abnormal soil erosion in other countries; Past and present state of Nyasaland: outstanding changes during the historical period; Factors influencing the degree of erosion in Nyasaland; Methods of native farmers in Nyasaland; Alleviation of conditions due to erosion; Changes in climate with denudation; Special measures and remedies in detail.

517. NORTHERN RHODESIA: *Cotton Investigations*, 1933. (*Ann. Rpt. Dpt. of Agr.*, 1933, recently received.) We give the following extracts from this report: "The work on cotton continued without interruption. The trend of future investigations is to be directed towards a better understanding of the inter-relationship of the stainer, its wild host plants and cotton. . . . Trial plots have been established in certain areas to determine the extent to which stainer populations are affected by the absence of perennial hosts.

"For the past five years the Empire Cotton Growing Corporation has seconded and paid the salary of an officer for cotton work in the Protectorate. Government has borne all other charges. It was impossible to continue to provide funds for this purpose, and abandonment of the work would have been enforced had not the Corporation, with characteristic generosity and promptitude, agreed to bear all charges in the coming year. This is the second occasion on which

the Corporation has averted a crisis, and its timely assistance is most gratefully acknowledged.

"The prospects of cotton growing as a European industry are not particularly promising, though a comparatively small rise in price would render the crop attractive on account of its rotational value. As a cash crop for natives within reach of the ginnery at Mazabuka, however, cotton has now distinct promise, and if the small-scale trials now being undertaken in native reserves are encouraging, it is hoped to make a cautiously planned commencement in the development of the industry in selected areas."

518. Practical Notes on a Suggested Rotation for the Fort Jameson District. By R. H. Fraser. (*Third Ann. Bull. Dpt. of Agr. N. Rhod.*, 1933, recently received.) The rotation suggested is: 1st and 2nd years, tobacco fertilized; 3rd year, green manure; 4th year, maize (or cotton, in the event of a rise in price). Trial plots of U.4 cotton over a period of three years have given an average return of 700 lb. seed cotton per acre, and as this variety is partially resistant to jassid, this should enable it to overcome some of the limiting factors previously responsible for the cessation of cotton-growing in this district. Unfortunately the prices at present ruling do not permit of export.

519. South Africa: *Cotton Cultivation*, 1933-34. (*Crops and Markets*, June, 1934.) The crop is estimated at 2,074 statistical bales of 500 lb. as compared with 1,488 bales last season. Damage by bollworm has been very heavy in some areas. Yields have also been reduced to some extent by flying swarms of locusts.

520. *Cotton Prospects.* Mr. T. G. Hesse, Manager of the Central Co-operative Cotton Exchange Ltd., Durban, writes as follows in *Market Notes No.* 2, issued by the Exchange in July: "A fair amount of cotton is now ready for the market, all ginneries having started operations. The quality is, on the whole, very satisfactory; the character is particularly good, as is the grade. . . . The developments now afoot in the cotton world tend to bring the supply of cotton into healthier relationship with demand, and this sounder statistical position that is being achieved must reflect itself in a better level of prices. This confirms the feeling that has been gaining ground, that cotton again deserves the attention of growers in Southern Africa, the more so as, thanks to the efforts of the Empire Cotton Growing Corporation, great strides have been made in the matters of seed supply and general knowledge of the crop and its problems."

521. Swaziland: *Cotton Cultivation.* (*Ann. Rpt. Emp. Cott. Growg. Corpn.*, 1932-33.) It is stated that increased interest is being taken in the cultivation of cotton by natives. Instructional plots were planted in the 1932-33 season to illustrate the best methods of cultivation and general handling of the crops. These were worked by the natives themselves, and the necessary instructions given by trained natives employed by the Corporation. If the crop is taken up, it will be of great value to the native not only as a welcome cash crop, but as being the means of introducing a system of crop rotation, and thus improving the native system of agriculture.

522. Sudan: *Cotton Cultivation*, 1932-34. (*Ann. Rpt. of Dpt. of Agr. and Forests*, 1933.) The 1932-33 cotton crop of the Gezira Irrigation Scheme was put in under unfavourable conditions of heavy rains, and consequently considerable areas were sown very late. Imported Egyptian Sakel seed was used which, before it entered the Gezira, was sunned and dusted with a germicidal powder at Khartoum North. A very thorough clean-up of ratoons and volunteer seedlings, which are a source of infection of leaf curl and blackarm, was carried out. In spite of these precautions, much damage to the crop was caused by both these

diseases. Little primary blackarm infection occurred, but practically all the cotton, except that which was sown very late, was severely attacked. Leaf-curl infection was heavy, particularly in the late-sown crop.

A particularly encouraging feature was the behaviour of certain selected strains of cotton in withstanding the adverse conditions of an unfavourable Gezira season. One of these, a direct selection from Gezira-grown Sakel, which has been under observation for several years, is very promising, and there are good grounds for believing that when its seed is available in bulk good crops will be harvested even in unfavourable seasons. A large quantity of this seed propagated in the Gezira and in the Gash Delta will be available in 1935. A number of other new strains are also giving promising results.

The 1933-34 cotton was put in under favourable conditions, and a good crop was anticipated. Unfortunately, however, exceptionally heavy rainfall caused blackarm to spread over large areas. Leaf curl was almost absent, this being due probably to the almost complete absence of ratoons, which resulted from the pulling up of the cotton stalks of the preceding crop. The operation of extraction, in place of the former method of cutting, was adopted with a view to reducing the carry-over of leaf curl from crop to crop.

Tokar and Kassala crops of 1932-33, in spite of a considerable incidence of leaf curl, were again good. Tokar established a new record with 95,513 kantars against the previous best of 72,041 kantars in 1921. In both cases Gash seed from the previous year's crop was sown.

The decrease in the amount of American cotton produced in 1932-33, both in the case of irrigated and rain-grown crops, was mainly attributable to low prices, bollworm damage in Berber Province, and to the lack of stored grain due to locust damage to the preceding rain-grown food crops. It was expected, however, that in the 1933-34 season there would be considerable expansion, particularly in rain-grown cotton production.

No new ginneries were licensed during 1933, but the existing ginning factories continued to function satisfactorily.

523. TANGANYIKA: *Cotton Industry.* (*Ann. Rpt. Emp. Cott. Growg. Corpn.*, 1932-33.) The new Government regulations for zoning the districts came into force in 1933. These aim at overcoming the evils arising from the movement of seed cotton by motor lorry over long distances. Not only does this practice lead to the risk of admixture of seed, but it is not in the best interests of the native producer, who has naturally had the cost of transport deducted from the price he received. Under the new Rules, no unginned cotton may be moved from one administrative district to another without permission. Steps have also been taken to safeguard growers against excessive ginning charges, to reduce the amount of tax taken as Cotton Cess, and, by means of a fair price scale, and supervision and check weighing, to protect the native grower against unfairly low returns. Notice has also been given that no new ginneries can be erected until the size of the crop justifies it, but old ginneries may be re-sited.

524. *Cotton Prospects*, 1934-35. The latest report from the Department of Agriculture is to the effect that in the Eastern Province prospects generally are good, and a record crop is anticipated from Rufiji. In the Lake Province, cotton prospects are good at Mwanza, the crop being very free from disease; in Maswa, however, jassid and aphis are prevalent. In Lindi Province the position is satisfactory in most districts.

525. TOGOLAND: *Cotton Cultivation.* (*L'Ind. Text.*, **51**, 1934, pp. 174 and 227. Abstr. from *Summ. of Curr. Lit.*, xiv., **14**, 1934, p. 354.) Most of the cotton cultivated is of the *G. barbadense* species, with a length of about 28-30 mm. A strain known as Togo Sea Island is generally grown. Promising results were

obtained in 1932-33 with Ishan cotton introduced from Nigeria. This cotton gave higher yields than the Sea Island variety, and had a mean length of 32-34 mm. Further tests are being made.

526. UGANDA: *Cotton Industry*, 1934. (*Crown Colonist*, July, 1934, p. 330.) From January to May 166,665 bales of cotton and 12,000 tons of cotton-seed were exported from the country, and the cotton tax collected during the period amounted to £21,387. Fears are expressed of a shortage of immigrant labour from the Congo this year, owing to sleeping-sickness, and this may affect the cotton crop on this side of the Nile.

527. *Cotton Prospects*, 1934-35. The latest report from the Dept. of Agriculture states that dry weather has been experienced in most districts, and in some cases has delayed planting. In Buganda Province early plantings have suffered from drought, and considerable re-sowing will be necessary. The estimated acreage planted to the end of June was 186,432 acres, compared with 173,294 acres for the same period in the previous season.

528. AUSTRALASIA. QUEENSLAND: *Cotton Cultivation*, 1933-34. (*Queens. Agr. J.*, xli., **4**, April, 1934, p. 397.) "Queensland's record crop of cotton is now being harvested, and the ginneries are working to full capacity. It has been found necessary to reopen the Gladstone ginnery—after it had been closed for a period of nine years—in order to deal with part of the crop. Arrangements have been made whereby it will be possible for about half of the crop to be absorbed by Australian spinners."

529. WEST INDIES. COTTON IN CARRIACOU. (*Trop. Agriculture*, xi., 7, 1934, p. 183.) Dr. Harland visited Carriacou in April to inspect the propagation and experimental plots of the long-staple Carriacou and Moco cotton selections in the island. During the last few years the Agricultural Assistant, Mr. F. Simmons, has been making selections from the Carriacou type of cotton, and has now obtained several new strains which appear to be very superior to those ordinarily grown. The selections have a mean maximum lint length varying from about 46 to 51 mm. Although some strains may later be discarded, and the results of spinning tests have not yet been received, Dr. Harland has recommended that the large-scale propagation of seven substrains should be immediately undertaken in order to replant the whole of the cotton-growing areas in Carriacou with the new types in the next two years. With this end in view the Government has made arrangements to rent 100 acres of land in 1934 for propagation and demonstration purposes, so that sufficient seed will have been produced in 1935 to plant 2,000 acres, and in 1936 to effect the complete substitution.

530. *Cotton Ginnery*. (*W. India Comm. Cir.*, xlix., **932**, 1934, p. 259.) The desirability of erecting a cotton ginnery, an oil-extracting plant and a cotton-seed heater in Carriacou was urged in the Legislative Council on May 16. It was considered that assistance should be sought from the Colonial Development Fund or other source.

COTTON IN EGYPT.

531. LA SITUATION COTONNIÈRE EN EGYPTE. By G. Minost, Director-Général du Crédit Foncier Egyptien. (*Assoc. Cotonn. Colon. Bull. No.* 15, 1934, p. 88.) The mean export of cotton from Egypt from 1925-9 was 51·5 millions of pounds (Egyptian); in 1930 it fell to 25·6 millions, in 1931 to 21·125, and in 1932 to 19·302 million pounds. The price obtained showed a similar fall, and it is pointed out that none of the measures taken by the Government had any influence on the price obtained, which was found mainly to follow that of American cotton.

532. Egyptian Cotton Bales: Moisture Tests. (*Cotton*, M/c., xl., 1934, No. 1914, p. 4. Abstr. from *Summ. of Curr. Lit.*, xiv., **11**, 1934, p. 293.) According to a progress report issued by the Alexandria Testing House, out of 2,888 tests carried out in respect of "Hydraulic" lots during the period October, 1933, to January 31, 1934, 72 per cent. of the total exceeded the limit of standard allowance for moisture—viz., 8 per cent ($8 \cdot 5 \pm 0 \cdot 4$ per cent.). The agreement relating to moisture in Egyptian cotton was originally adopted at the International Cotton Congress, Paris, in 1931, renewed at the Prague Conference last year, and is to remain in force without any change until September, 1936.

533. Replacement of American and other Staple Cottons by Egyptian Uppers and Zagora. Joint Egyptian Cotton Committee. (*Int. Cott. Bull.*, xii., **47**, 1934, p. 309.) Details are given of mills using American and Egyptian cottons, and it is stated that with a 5 per cent. premium over American cotton it pays to use Egyptian. The spinning of Zagora and Uppers in a mill that usually spins American cotton only requires the cards to be run slower, and if possible the card clothing should be finer, though this is not an absolute necessity for 36's and 40's. Ashmouni and Zagora cottons are stated to be stronger and less neppy than American cotton.

534. Généralités sur les Assolements en Egypte. By J. Anhoury. (*Bull. de l'Union des Agriculteurs d'Egypte, No.* 247, 1933, p. 738. Abstr. in *Coton et Cult. Cotonn.*, viii., **3**, 1933, p. 192.) States the most suitable rotations in Egypt for good land and for medium land.

COTTON IN THE UNITED STATES.

535. The U.S. Cotton Situation. By W. Whittam. (*Text. Rec.*, lii., **614**, 1934, p. 17.) A discussion of the Cotton Control (Bankhead) Act.

536. Progress in Agricultural Adjustment. We quote the following paragraphs from the editorial in the *Exp. Sta. Rec.*, 70, **6**, 1934, p. 737: "Under the title of 'Agricultural Adjustment: A Report of Administration of the Agricultural Adjustment Act, May, 1933, to February, 1934,' a comprehensive volume of approximately 400 pages has recently been issued by the Federal Department of Agriculture. This is the first extensive report of the stupendous and unprecedented activities initiated less than a year ago in the effort 'to adapt American agriculture to changed conditions.' It supplements the outline of general policies contained in the annual report of the Secretary of Agriculture with 'a complete and detailed description of what has been done toward effectuation of these policies and the purposes of the Agricultural Adjustment Act.'

"The report opens logically with a discussion of the objectives and mechanisms. It cites as the underlying incentive of the legislation the severe disparity prevailing between prices of farm products and other products, the immediate cause of which is ascribed to the pressure of surpluses on the market, and it discusses the steps taken under the legislation to 'relieve the existing national economic emergency by increasing agricultural purchasing power.'

"The Act was approved May 12, 1933. It is pointed out in the foreword that despite the short time it has been in operation, 'a partial measure of economic recovery has been brought to American agriculture. Total farm income from crops in 1933, including rental and benefit payments, is estimated to have been \$3,271,000,000 as compared with \$2,113,000,000 in 1932, an increase of nearly 55 per cent. Part of this recovery was undoubtedly due to the adjustment programme just getting under way. . . .'

"An idea of the vastness of the undertaking is revealed in a summary of salient facts relating to cotton. From this it appears that 1,026,514 cotton-growers

carried out adjustment contracts with the Government in 1933, embodying 73 per cent. of the total acreage and removing from production 4,400,000 bales of cotton. The cash rentals on the land thus taken out of production amounted to $112,000,000, and the increase in farm values of the cotton crop (seed and lint) for 1933 over 1932 reached a total of $431,760,000 or 101·5 per cent."

537. AMERICAN COTTON BALES: MOISTURE CONTENT. By C. D. Honiker. (*Cotton, U.S.*, 98, **4**, 1934, p. 45. Abstr. from *Summ. of Curr. Lit.*, xiv., **12**, 1934, p. 317.) The following figures for moisture content percentage are given as the result of sampling not less than 30 bales per year at a mill in Atlanta:

	1923.	1924.	1925.	1926.	1929.	1930.	1931.	1932.
Maximum ...	13·8	17·6	10·4	14·5	14·2	13·7	10·4	10·8
Minimum ...	6·2	5·0	5·7	7·4	6·7	5·5	5·6	5·9
Average ...	9·2	10·7	7·8	9·9	10·2	8·9	7·6	7·9

538. GRADE, STAPLE LENGTH, AND TENDERABILITY OF COTTON IN THE UNITED STATES, 1928-29 to 1931-32. (*U.S. Dpt. Agr. Stat. Bull.* 40, 1933. Abstr. from *Exp. Sta. Rec.*, 70, **5**, 1934, p. 707.) The data used were collected in co-operation with the California State Dept. of Agriculture and the Agricultural Experiment Stations of Alabama, Arizona, Arkansas, Florida, Georgia, Louisiana, Mississippi, Missouri, New Mexico, North Carolina, Oklahoma, South Carolina, Tennessee, and Texas.

Tables show (1) for the United States and each of the States for the crops of 1928, 1929, 1930, and 1931, the quantities of American Upland cotton of different grades and staple lengths ginned, the quantities of different grades and staple lengths ginned during specified periods of each year, and the quantities of $\frac{7}{8}$ to $1\frac{1}{32}$ in. and $1\frac{1}{16}$ in. and longer cotton tenderable in settlement of futures contracts made subject to the United States Cotton Futures Act and the regulations of the Secretary of Agriculture thereunder; (2) by designated districts for Alabama, Arkansas, Georgia, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, and Texas the quantities of different staple lengths ginned during each of the four years; and (3) the quantities of different grades and staple lengths on hand in the United States on August 1 of each year.

Other tables show similar data for the United States for American-Egyptian cotton, the quantities of Egyptian and other foreign cotton on hand in the United States on August 1 each year, and the quantities of American Upland cotton of different grades and staple lengths ginned in Georgia and in Oklahoma and Texas from the 1927 crops.

539. ECONOMIC ASPECTS OF THE GRADE AND STAPLE LENGTHS OF COTTON PRODUCED IN OKLAHOMA. By R. A. Ballinger and C. C. McWhorter. (*Okla. Sta. Bull.* 212, 1933. Abstr. from *Exp. Sta. Rec.*, 70, **6**, 1934, p. 850.) This study, which covers the 1928-32 crops, is a unit in the co-operative study being made by the Bureau of Agricultural Economics, U.S.D.A., and the State experiment stations in the cotton States. Tables and charts show by years for the United States, Oklahoma, and each of 11 sections of the State the number of bales and percentages of total crops of different grades, staple length, and tenderability on contracts; and for the State the percentages of bales of different grades and staple lengths ginned during specific periods of the season. The effects of variety, method of picking, climate, soil, and ginning on grade and staple length are discussed, with tables and charts.

540. ARIZONA. *Field Crops Experiments.* (*Arizona Sta. Rpt.*, 1933. Abstr. from *Exp. Sta. Rec.*, 70, **6**, 1934, p. 761.) Work on cotton included varietal tests, breeding experiments, effects of water shortage on internal plant structure and

upon nutrition as affecting boll-shedding, relation between osmotic pressures in the sap and lint length, and grade and staple estimates of the Arizona crop.

541. CALIFORNIA. "*One Variety*" *Cotton Community: Organisation.* By J. E. Hite. (*U.S. Dpt. Agr. Circ. No.* 286, 1933. Abstr. from *Summ. of Curr. Lit.*, xiv., **11**, 1934, p. 275.) Particulars are given of the marketing and seed distribution organisation involved in the production of Acala cotton in the San Joaquin Valley, California, and the history of the "one variety" movement is outlined. In 1930, 238,200 acres were under Acala, yielding an average of 495 lb. of lint per acre.

542. NORTH CAROLINA. *Field Crops Research*, 1931-32. By E. G. Moss *et al.* (*N. Car. Sta. Rpt.*, 1932. Abstr. from *Exp. Sta. Rec.*, 70, **6**, 1934, p. 762.) Work on cotton included varietal trials, breeding, cultural and fertilizer tests, cotton fibre studies, and rotation experiments.

543. TEXAS. *A Pioneer One-Variety Cotton Community in Collin County.* By R. F. Saunders. (*U.S. Dpt. Agr. Circ.* 293, 1933. Abstr. from *Exp. Sta. Rec.*, 70, **5**, 1934, p. 707.) The conditions leading up to and the efforts in organizing the Collin County Standardization Association, the problems and difficulties of the Association, and the results obtained, are described.

COTTON IN FOREIGN COUNTRIES.

544. BELGIAN CONGO: *Rapport annuel sur la culture et le commerce du coton dans la Province Orientale*, 1931-32. (*Bull. Agr. du Congo Belge*, xxiv., **3**, 1933, p. 352.) The total production of the Eastern Province for the season 1931-32 was 19,269,895 kilos, as compared with 33,449,600 kilos in the previous season. The chief malady was the "chancre des tiges," attributed to the bites of Helopeltis. Improved seed is being distributed.

545. CONTRIBUTION À L'ÉTUDE DES PLANTES TEXTILES CULTIVÉES AU CONGO BELGE. By J. B. H. Lejeune. (*Bull. Agr. du Congo Belge*, xxiv., **4**, 1933, p. 475.) Thirty-eight textile plants are under trial, of which *Abroma augusta* has given much the largest crop (5,442 kilos) per hectare.

546. BELGIAN CONGO: *New Railway.* (*Soir*, 7/7/34.) The new Congo-Ocean line from Brazzaville in Belgian Congo to Pointe Noire in French Congo, where a new ocean port is being constructed, was opened by the Governor-General of French Equatorial Africa on July 11.

547. BRAZILIAN COTTON: CONTROL. (*Times Trade and Eng. Suppl.*, **34**, 1934, p. 135. Abstr. from *J. of Text. Inst.*, xxv., **6**, 1934, A275.) The Brazilian Government has ordered the registration and inspection of all ginning machines with a view to improving the appearance of Brazilian cotton. The export of cotton which has not been ginned and packed under the supervision of the Department of Textile Plants is prohibited. The 1934 crop in Sao Paulo approaches 90,000 metric tons, and the total production of other Brazilian states is estimated at 103,500 tons, leaving a balance of over 90,000 tons for export, the bulk of which will probably be taken by Japan at special rebated freight rates.

548. CHINA: *Cotton-Growing Experiments.* (*Man. Guar. Coml.*, 23/6/34.) Seventeen centres are being opened in China for experimental work in connection with cotton cultivation. Special attention will be paid to improving soil conditions for cotton-growing, and to the choice of seed.

549. ASSOCIATION COTONNIÈRE COLONIALE. *Bull. No.* 15 contains the following: "La situation cotonnière en Egypte" (E. Minost); "L'intervention de l'autorité administrative dans la culture du cotonnier" (V. Cayla). The bulletin also contains the Annual Report of the Association, presented by M. Hesling, Director General, and notes on cotton in the French Colonies, cotton legislation, etc.

550. L'Intervention de l'Autorité Administrative dans la Culture du Cotonnier. By V. Cayla. (*Assoc. Cotonn. Colon., Bull. No.* 15, 1934, p. 90.) The case of Egypt, where, in spite of the wishes of consumers, Mit-Afifi "degenerated" in the hands of the small cultivator and was replaced by Sakel, is taken as an example, and it is concluded that there should be strict control of the small cultivators in the French Colonies, that "one type one district" should be carried out, and that insect pests should be controlled by all suitable measures.

551. Germany: *Bremen Cotton Exchange.* (*Wirtschaftsdienst*, 29, 1934, p. 884. Abstr. from *Summ. of Curr. Lit.*, xiv., **14**, 1934, p. 355.) The nature and aims of the Exchange are briefly explained. It exists to represent the interests of the German cotton industry, to decide controversies, and to fix the prices of goods. The bulk of the raw cotton imported by Germany passes through Bremen. In 1933 imports amounted to 1,033,000 bales of American, 132,000 of Indian, 122,000 of Egyptian, and 93,000 bales of sundries.

552. Greece: *Textile Developments.* (*Text. Weekly*, xiii., **328**, 1934, p. 406.) The development of the Greek cotton spinning and weaving industry is reported to be such that 60 per cent. of the total requirements of the home market can now be satisfied. It is hoped that in three years' time production will have reached a stage when imports can be dispensed with.

553. The Japanese Textile Trade. (*Text. Weekly*, xiii., **334**, 1934, p. 556.) A comparison of the business and financial results.

554. Persia: *Home Textile Industry.* (*Text. Weekly*, xiii., **334**, 1934, p. 554.) With the object of reducing imports of textiles, more particularly from Japan, Persia is in process of developing her own textile industry. There are five spinning and weaving mills, with 20,500 spindles, already in existence, and another three mills, with 12,100 spindles, are to come into operation this year.

555. Russia: *Cotton Production.* (*Cotton*, 18/8/34.) According to provisional reports, the cotton harvest in the Soviet Union promises to be a good one this year. Sowing has been carried out with greater efficiency than in previous years. Special attention has been paid to long-fibred types of American and Egyptian cotton, about a quarter of the total area being planted with these varieties.

556. Russian Cotton: Production. By M. Wagner. (*Wirtschaftsdienst*, 29, 1934, p. 895. Abstr. from *Summ. of Curr. Lit.*, xiv., **14**, 1934, p. 354.) Increase in acreage over that before the war has made Russia self-supporting as regards cotton. Costs are high, however, and the staple appears to be becoming shorter; financial loss also results from inefficient processing.

557. Russian Cotton Industry: Progress. (*Revue Text.*, 32, 1934, pp. 79 and 241. Abstr. from *J. of Text. Inst.*, xxv., **6**, 1934, A319.) Figures are given for qualities and types of raw material used, numbers of spindles and looms, working hours and production in recent years, together with the estimates for the second five-year plan period, 1933-1937. It is pointed out that a considerable proportion of the textile goods produced is of poor quality, but owing to the great demands of the home market it is possible to sell even very poor qualities.

558. The Rôle of Indian Cotton Growing in the National Economy of U.S.S.R. By G. V. Kovalevsky. (*Bull. Appl. Bot.*, Ser. A, **8**, p. 173, Leningrad, 1933. From *Plant Breeding Abstracts*, iv., **4**, 1934, p. 319.) On account of their extreme earliness, tolerance, high yield and ginning percentage, the Indian cottons are of considerable interest to the U.S.S.R. Reference is made to the successful combination by hybridization in India of yield and length of lint, and of cotton resistance to wilt and other diseases. The various improved cottons produced in the different Presidencies in India are described, and other matters

in which the Soviet Union might benefit by Indian research and experience are mentioned.

559. THE EGYPTIAN COTTON PLANT IN TRANSCAUCASIA. By F. M. Mauer. (*Bull. App. Bot.*, Ser. A, **8**, p. 147, Leningrad, 1933. From *Plant Breeding Abstracts*, iv., **4**, 1934, p. 318.) The history of the introduction of Egyptian cottons into the U.S.S.R. is briefly traced, and the climatic conditions of the cotton-growing regions of the U.S.S.R. compared with those of Egypt. The varieties at present in widest cultivation are briefly described, and the results of recent variety tests presented.

Breeding work was begun in 1931 by ZakNIHI. The origin and characteristics of the best selections used for breeding material are given. The American Egyptian and the Upper Egyptian types have proved the most suitable to the region, and all the best selections of the last few years have come from these cottons. The other two groups, Lower Egyptian and Sea Island proper, are less favourable. All these varieties have, however, a number of serious defects which are absent in many of the cottons introduced direct from South America, Peru and Brazil in particular. Some of these have very large bolls, weighing 7-9 g., a ginning outturn up to 40 per cent., lint length up to 50 mm., and the greatest possible diversity in form of bush; some of them display resistance to bacterial diseases, others extreme earliness. By using these cottons in hybridization it will be possible to create new forms of Egyptian cotton very much better suited to the district.

560. THE ORGANIZATION OF RESEARCH: ITS PLACE IN THE SOVIET SOCIAL SYSTEM. By J. G. Crowther. (*Man. Guar. Coml., Soviet Union Number*, 2/6/34.) Scientific research is provided as a necessary part of the social system, and is largely organized on team-work lines.

561. RESULTS OF EXPERIMENTS WITH COTTON AT THE BARDIN EXPERIMENTAL SECTION OF ZAKNIHI (1929-30). By A. M. Masenko. (*Bull. ZakNIHI. Sci. Ser. No.* 38, 1933. From *Plant Breeding Abstracts*, iv., **4**, 1934, p. 321.) In the section of variety testing, trials were carried out in 1929 with 20 varieties of American cotton; Egyptian varieties, which also thrive well, were only introduced in 1931. The highest in gross yield and in yield of lint were the medium early varieties, followed by the medium late.

562. RESULTS OF TRIALS WITH COTTON IN THE KUBAN FOR 1930. By J. E. Penzin. (*Publ. Cott. Res. Inst. for New Regions*, Simferopol, 1931, i., p. 47. From *Plant Breeding Abstracts*, iv., **4**, 1934, p. 318.) Trials were carried out on varieties obtained from the Central Asia NIHI and the Transcaucasian NIHI, and on certain special new early maturing varieties from the former, but none proved entirely suitable to the region.

SOILS AND MANURES.

563. LECTURES ON SOIL MICROBIOLOGY. By A. Rippel. (*Vorlesungen über Boden-Mikrobiologie.* Berlin: Julius Springer, 1933. Abstr. from *Exp. Sta. Rec.*, 70, **5**, 1934, p. 590.) The book deals with the significance and methods of soil microbiology; distribution of micro-organisms in the soil; the carbon, sulphur, nitrogen, and iron cycles; formation and decomposition of humus materials; microbiological influences in the soil; determination of soil fertility by microbiological methods; microbiology of water; and the preservation of organic substances.

564. THE USE OF INDICATORS FOR THE QUALITATIVE DETERMINATION OF SOIL REACTION. By H. J. Harper. (*Soil Sci.*, xxxvi., **6**, 1933. Abstr. in *Exp. Sta. Rec.*, 70, **5**, 1934, p. 580.)

565. A Method for the Continuous Automatic Extraction of Soils. By J. C. Russel. (*Soil Sci.*, xxxvi., **6**, 1933. Abstr. from *Exp. Sta. Rec.*, 70, **5**, 1934, p. 580.) Describes a simple device capable of being set up in batteries of 12 or more, and providing for the completion of the extraction with a relatively small volume of extractant. A drawing indicates the construction of the apparatus, and tabulations of experimental data show the rate at which water-soluble and exchangeable components may be extracted.

566. Determination of Nitrogen in Soils. III. Further Observations on the Protective Action of Silica, and their Bearing on the Estimation of Nitrogen in Substances which are Admixed with Soil or are otherwise Rich in Silica. By A. Srinivasan. (*Ind. Jour. Agr. Sci.*, iv., **2**, 1934, p. 320.)

[*Cf.* Abstr. **244**, Vol. X., and **77**, Vol. XI., of this Review.]

567. A New Method for Estimating Replaceable Na and K in Soils. By A. N. Puri. (*Soil Sci.*, xxxvi., **5**, 1933. Abstr. from *Exp. Sta. Rec.*, 70, **5**, 1934, p. 581.) The author presents in working detail a method dependent upon the use of barium hydroxide as a replacing reagent. The sodium and potassium are thus made to appear in the leachings as their hydroxides, and are determined by the titration of their carbonates after the calcium and barium have been removed by precipitation with carbon dioxide.

568. Cotton Growing on New Cultivations. By W. G. Wells. (*Queensland Agr. Jour.*, xli., **4**, April, 1934, p. 362.) Discusses the subject under the following heads: Nitrate Content of Soils; Effect of Carbon-Nitrogen Ratio; Moisture Penetration; Methods of Improving Soils; Rhodes Grass Suitable for Forest Soils; Time of Breaking-up New Cultivations; Rate of Planting on New Cultivations.

569. Soil Erosion. (*Exp. Sta. Rec.*, 70, **6**, 1934, p. 894.) What is known as an experimental erosion nursery is being established at the Iowa Station in co-operation with the U.S.D.A. Bureau of Plant Industry. The purpose of the nursery will be to select and propagate trees, shrubs, grasses, etc., which may be used in controlling soil erosion. Plant materials from the United States and foreign countries will be tested. It is the intention to propagate only in sufficient quantities to permit of thorough testing in Iowa and parts of adjoining States.

570. Soil Erosion. By P. H. Haviland. (*Rhod. Agr. Jour.*, xxxi., **6**, 1934, p. 420.) The various sections of this paper are headed: General Natural Erosion; Æolian Erosion; Evaporation; Erosion by Water; Effects of Vegetation; Methods for Prevention and Reclamation; Veld Burning and Bush Cutting; Over-stocking; Roads and Paths; Protection of Cultivated lands; Storm Drains; Gulleys and Washouts; Cattle and other Tracks.

The author states that in Southern Rhodesia prevention of soil erosion by means of ridge terraces (contour ridges) is extending, some 569 miles being now pegged out. A general account is given of the methods of working, with diagrams, and the paper should prove of use to anyone who is undertaking work on the prevention of soil erosion.

571. Some Aspects of Soil Erosion. By R. S. Adamson. (*J. of the Bot. Soc. of S. Afr.*, xix., 1933. Abstr. from *Trop. Agriculturist*, lxxxii., **4**, 1934, Ceylon, p. 238.) Deals with the soil erosion problems of the South-Western Cape region of South Africa.

572. Soil Erosion Studies. By M. L. Nichol and H. Sexton. (*43rd Ann. Rpt. Agr. Sta., Alabama Poly. Inst.*, 1932, p. 9.) Mechanical analyses showed that in all cases the losses were in the finer separates. With an inch of rain in 8½ minutes the loss on level plots was 623 lb. an acre; in 16½ minutes it was 336 lb. Ploughing increases erosion when the land is saturated, but contour rows reduce erosion very materially.

573. Soil Erosion Control by Terraces. By C. E. Ramser. (*Eng. News Rec.*, iii., **15**, 1933, p. 437. Abstr. from *Exp. Sta. Rec.*, 70, **4**, 1934, p. 541.) Summarizes the results of research at the several soil erosion experimental farms on the influence of terrace slope, spacing, and length upon the waste soil and water. Outstanding among the results obtained on the design of terraces is the information collected on the farm at Tyler, Texas, which supports the recommendations made in 1916 that a terrace with a variable grade is more effective in controlling erosion than a terrace with uniform grade.

CULTIVATION, IRRIGATION, GINNING, USE OF SEED, ETC.

574. Cotton Spacing in Southern Louisiana in Relation to Certain Plant Characters. By J. R. Cotton and H. B. Brown. (*La. Bull. No.* 246, 1934.) From the summary we quote the following: " Closely-spaced plats had the shortest plants, but the total plant growth was greatest on them. Close spacing increased earliness as measured by rate of blooming early in the season and by the per cent. of crop harvested at the first picking. Closely-spaced plants have more blooms early in the season, and wider-spaced plants later. A spacing of two stalks 10 inches apart, gave the largest number of blooms for the season. The rate of shedding was greatest in the unthinned cotton, and decreased as the spacing was widened. The size of the boll increased regularly as the spacing was widened. Boll rot was somewhat more prevalent in the closely-spaced plats than in the wide spaced. The spacing distances used appeared to have no effect on lint percentage. Under some conditions close spacing appeared to shorten the staple length. Unthinned cotton (about 59,000 plants to the acre) gave the lowest yields on both bench and alluvial lands. A spacing of two stalks, 20 inches apart, in 4-foot rows, gave the best yields on both types of soil used, but the differences between the yields of the spaced plats were not significant."

575. Iarovization (Vernalization) in Field Practice. By J. H. Martin. (*U.S. Dpt. Agr. Bur. Pl. Ind.*, 1934. [Mimeographed.] From *Plant Breeding Abstracts*, iv., **4**, 1934, p. 280.) Vernalization is not a new phenomenon, and experiments are quoted from the middle of the last century showing that by the application of low temperatures to the seed winter cereals were induced to head when spring sown. Experiments were made to test the possibility of using vernalized winter wheat as a substitute for spring wheat, or for re-seeding winter wheat which had failed. Vernalization was successful, but the yields did not compare favourably with those of spring wheat, still less with those of winter wheat autumn sown. The length of time required for successful vernalization, in many varieties amounting to 65 days, is another drawback which deprives it of its advantage over winter seeding or the use of a spring variety. The practical and economical difficulties of applying low temperature treatment on a large scale are mentioned as a further very serious drawback. Experiments to test the efficacy of high temperature vernalization applied to sorghum have all so far given negative results. The author is of opinion that the value of vernalization is largely confined to its use in experimentation, as, for instance, by breeders to procure two generations in one year.

576. Vernalization. By J. C. Haigh. (*Trop. Agriculturist*, lxxxii., **4**, 1934, Ceylon, p. 214.) Discusses the similarity between the Russian process and the methods used by the Sinhalese paddy cultivator.

577. Super-optimal and Thermal Death Temperatures of the Cotton Plant as affected by Variations in Relative Humidity. By D. M. and E. E. Berkley. (*Ann. Missouri Bot. Gard.*, xx., **4**, 1933, p. 583. Abstr. from *Exp. Sta. Rec.*, 70, **5**, 1934, p. 600.) Upland cotton plants from 5 to 180 days

old were exposed to super-optimal and thermal death temperatures for periods ranging from 0·5 minute to 72 hours. In one series the plants were exposed to temperatures below 42-84° C. at an average relative humidity of 69 per cent. at temperatures below 50°, while in the second series plants were exposed to 40-65° at an approximately saturated atmosphere.

Seedlings resisted high temperatures less than older plants at any given relative humidity, and the plants were less resistant to high temperatures at a higher relative humidity. Leaves and cotyledons were affected first at the higher relative humidity, while the seedlings' hypocotyls and petioles and young stems of older plants were affected first at the lower relative humidity. The cotyledons lost water rapidly with treatment at the lower humidity, while the hypocotyls lost very little. After removal from the treating chamber, the cotyledons regained much of the water lost and became turgid again, whereas the hypocotyls continued to lose moisture until completely withered. The saturated atmosphere of the second series seemed to have the additional effect of smothering the plants. The authors tentatively define the thermal death point.

578. NOTES PRATIQUES SUR LA CULTURE DU COTON SAKELLARIDIS DANS LES TERRES DE MOYENNE CAPACITÉ. By J. Anhoury. (*Bull. de l'Union des Agriculteurs d'Egypte, No.* 248, 1933, p. 823. Abstr. in *Coton et Cult. Cotonn.*, viii., **3**, 1933, p. 193.) Clayey or clay-silicious soils are very favourable to the culture of Sakel. Silicious-clay soils are less favourable, and instructions are given for their treatment.

579. THE EFFECT OF PICKING DATE OF PARENT SEED ON SOME ECONOMIC CHARACTERS OF THE COTTON PLANT. By C. Jaganatha Rao. (*Madras Agr. J.*, xxi., **1**, 1933, p. 28. Abstr. from *Exp. Sta. Rec.*, 70, **4**, 1934, p. 469.) Observations during two seasons on boll characters of parent plants and progeny of a pure line of *Gossypium indicum* picked at brief intervals over 47 days showed that seed cotton, seed weight, and lint weight decreased distinctly in value as the season advanced, while lint length and ginning percentage fell off only slightly. With ovules and seeds per lock the decline was preceded by a rise. The high or low parental value occurring as a seasonal variation seemed to have no influence on the progeny average, and, except as modified by the seasonal and environmental influences surrounding the progeny, the average of the offspring tended to regress to the mean value of the parent.

580. VARIATIONS IN THE CHARACTERS OF COTTON FIBRES WITH THE PROGRESS OF THE SEASON. By K. R. Sen. (*Ind. Jour. Agr. Sci.*, iv., **2**, 1934, p. 295.) The present paper is intended to trace qualitatively the effects of climatic conditions on the cotton crop in so far as they induce variations in fibre characters with progressive pickings. The observations were made during two successive seasons, and the material used for the studies consisted of three Punjab-American cottons—viz., Early Strain, 4F and 289F, grown at the Cotton Research Farm, Lyallpur.

The following conclusions are presented:

(1) There was progressive deterioration of some of the fibre characters (maturity and fibre weight), with progressive decrease of soil and air temperatures; (2) there is no correlation between seed index and the average fibre length; (3) the present results agree with Kottur's in so far as there is no correlation between the average fibre length and ginning outturn; (4) there is a significant correlation between fibre maturity and fibre weight per cm. during the different pickings in the course of a season; (6) the average number of fibres of different length per seed is considerably greater at the beginning and end than at other times of the season.

With particular reference to the Early Strain, it was found: (i.) That there

is no significant correlation between fibre strength and fibre weight per unit length; (ii.) there is high correlation between torsional rigidity of fibres and fibre maturity or fibre weight per cm.; (iii.) there is a slight tendency among the fibre strength values to progressively deteriorate towards the latter part of the season in a similar way to the values of fibre maturity or fibre weight per cm.; (iv.) that apparently the torsional rigidity of fibres diminishes progressively as the season advances, the difference between any two pickings, provided the pickings are sufficiently apart, is generally significant (in the case of the present experiments the difference between the consecutive pickings was insignificant, however, during the middle and the extreme end of the season); (v.) the percentage of immature fibres definitely increases towards the end of the season. This last conclusion holds for 289F also, but for 4F the percentage is high towards the middle of the season.

As a general effect of picking on fibre characters, it may be stated that the early maturing variety of the Punjab-American cottons grown at Lyallpur seems to be more liable to variation in the important fibre characters than the late maturing varieties.

581. Relation of the Quality of Cotton Planting Seed to Length of Staple. By J. H. Moore. (*Bull. N. Car. Agr. Exp. Sta. No.* 296, 1934. From *Plant Breeding Abstracts*, iv., **4**, 1934, p. 320.) Data collected in 1930-33 showed that improved seed stocks give higher yields under farm conditions than unimproved or mixed seed, and also that pure and improved seed stocks are the main factors in producing uniform $\frac{15}{16}$ and $1\frac{1}{16}$ inch staple.

582. The Effect of Fertilizers and Rainfall on the Length of Cotton Fibre. By E. B. Reynolds and D. T. Killough. (*J. Amer. Soc. Agron.*, xxv., **11**, 1933, p. 756. Abstr. from *Exp. Sta. Rec.*, 70, **6**, 1934, p. 767.) Examination of the fibres of Mebane cotton grown in 1927-29 on variously fertilized or manured Lufkin fine sandy loam at the Texas Experiment Station did not reveal any significant correlation between the percentages of nitrogen, phosphoric acid, or potash, and the length of cotton fibre, although there was a slight tendency for potash to reduce it. On Kirvin fine sandy loam at Troup, Texas, in 1929, nitrogen and potash did not affect fibre length appreciably, although applications of phosphoric acid increased lint length somewhat. Significant increases or decreases in length of lint apparently produced by some of the fertilizers probably were not large enough to be detected in commercial classing. The length of fibre at the station was correlated positively with the amount of rainfall during boll development in two of the three years, but no correlation was apparent between rainfall and length of fibre in 1929 at Troup.

583. Uniformity of Cotton Fibre determined by Field Inspection. By O. F. Cook and A. Y. Willis. (*Circ. No.* 310, U.S. Dpt. of Agr., 1934.) The subject is discussed under the following headings: Introduction; Need of uniform cotton; Relation of buyers to producers; Genetic and environmental uniformity; Staple and substaple; Substaple as waste; Substaple in relation to classing; Range of fibre lengths in classing; Avoiding excess substaple; Avoiding damaged fibre; Preclassing community cotton; Community advantages in marketing; Conclusions.

584. Some Aspects of Drought Resistance, with Special Reference to Cotton. By R. Sankaran. (From *Plant Breeding Abstracts*, iv., **4**, 1934, p. 267.) A comparative study of the root system, leaf, leaf-water content, and the osmotic pressure of *Gossypium herbaceum* and *G. indicum* cottons was made at the Cotton Breeding Station, Coimbatore, Madras, in order to investigate their relative drought resistance. As compared with *G. indicum*, *G. herbaceum* was found to

have a deeper and thicker tap root, a denser covering of hairs on the leaves, and more water in its leaves both under ordinary field conditions as well as at the stage of permanent wilting of the plant—all adaptations making for better drought resistance.

585. ROOT DEVELOPMENT OF COTTON, PEANUTS, AND TOBACCO IN CENTRAL OKLAHOMA. By W. E. Bruner. (*Okla. Acad. Sci. Proc.*, 12, 1932. Abstr. from *Exp. Sta. Rec.*, 70, **6**, 1934, p. 763.) The root development of Mebane cotton, peanuts and tobacco grown in a fine sandy reddish-brown loam soil in 1925-6 is described and illustrated.

586. CUTTING COTTON STICKS BY MEANS OF A BULLOCK-DRAWN IMPLEMENT. By C. K. Rasul. (*Seasonal Notes*, xii., **1**, 1934, p. 14. Punjab Agr. Dept.) Describes a device consisting of two long knives fitted to the frame of a bar harrow (light harrow with triangular wooden frame and 17 steel points), which has been successfully used by the Department of Agriculture, Punjab, for quickly cutting cotton sticks.

587. AGRICULTURAL MACHINERY. We have received from Messrs. Ransomes, Sims and Jefferies, Ltd., a copy of an excellently illustrated pamphlet, showing the various machines manufactured by this firm—ploughs, tractors, cultivators, harrows, planters, lawn mowers, etc.—in operation in various parts of the world.

PESTS, DISEASES, AND INJURIES, AND THEIR CONTROL.

588. EXPERIMENTAL STUDIES IN INSECT PARASITISM. I. INTRODUCTION AND TECHNIQUE. II. SUPERPARASITISM. By G. Salt. (*Proc. Roy. Soc.*, 114, No. B790, 1934. Abstr. from *Rev. App. Ent.*, xxii., Ser. A, **4**, 1934, p. 203.) The object of this series of experiments was to study under controlled conditions the rate of increase of a parasitic species and its effect on the host population. The species chosen was *Trichogramma evanescens*, Westw., which has a life-cycle of only 10 days at 25° C. (77° F.), and is very tolerant of artificial conditions. As it attacks its hosts in the egg-stage, their exposure can be standardised. In these studies, the host used was *Sitotroga cerealella*, Ol., or occasionally *Ephestia kühniella*, Zell. Hosts and parasites were both of a pure strain of known pedigree; the individual history of each insect was known, and each was treated in a standard fashion and taken for experiment at random.

To ensure standard exposure, one host egg was placed in each $\frac{1}{100}$ sq. in. of graph paper pasted on cardboard discs fitting into uniform petri dishes. All adults that had emerged within the last two hours were taken from a stock culture of the parasite and collected into a vial, the cork of which was fitted with a piece of blotting paper soaked in diluted honey. After a further two hours in the incubator, individuals were isolated in small vials. One female was then placed in each dish containing host eggs, and the dishes immediately placed in the incubator. At the end of the experimental period, the females were removed and the dishes returned to the incubator. On the fifth day, the parasitized eggs, which had then turned black, were counted and their distribution noted by marking their position on a similar piece of graph paper. On the fifteenth day, when the parasites had all emerged and died within the dish, they were collected and their number and sex recorded. This procedure was modified according to the object of the experiment.

In view of the frequent occurrence of superparasitism in nature, it has hitherto been generally assumed that the females cannot distinguish hosts that are already parasitized. A statistical analysis, however, of field data relating to natural parasitism by *Collyria calcitrator*, Grav., and *Ibalia leucospoides* Hochenw., and

by *Sesioplex* (*Limnerium*) *validus* Cress., studied as a parasite of *Malacosoma americana* F., in the United States, shows that these parasites do not oviposit indiscriminately. Females of *T. evanescens* placed among groups of host eggs were observed to avoid ovipositing in those already attacked, and were able, at least for a time, to retain their eggs, depositing fewer than they were actually capable of laying. When the number of host eggs is limited, however, 2, 3 or even 4 eggs may be laid in some of them, but the number of cases of superparasitism is far smaller than would be expected to result from indiscriminate oviposition. When the number of hosts was limited, the larger individuals were selected for superparasitization. Thus, when the numbers of parasite and host are equal, there results neither the 100 per cent. parasitism to be expected from a perfect distribution, nor the 63 per cent. to be expected from an entirely indiscriminate one, but an intermediate percentage that cannot be accurately predicted.

This invalidates several of the formulæ that have been developed to represent the interaction of parasite and host populations, since it is no longer possible to superimpose the rate of reproduction of the parasite on that of the host, and suppose that the result represents the interaction of their populations. The faculty of discrimination apparently occurs also in the Braconid, *Dacnusa areolaris*, Nees. It would seem, therefore, to be widespread among parasitic Hymenoptera. Among the parasitic Diptera, discrimination is still unrecognized. It obviously cannot apply to Tachinids that deposit eggs on leaves to be eaten by the hosts. Incomplete data on the larvæ (planidia) of *Perilampus* spp., which seek their own hosts, suggest that they actually tend to concentrate in certain individuals. Some parasites that attack very active hosts are unable to examine them, since they must deposit their eggs and escape before they are injured. An example of this type is *Apanteles melanoscelus* Ratz., oviposition of which in larvæ of the gipsy moth (*Porthetria dispar*, L.) takes about one second. A different method by which superparasitism is avoided is shown in the case of *Alysia manducator* Panz., which stimulates pupation of its Muscoid host, so that the latter crawls at once off the carcase and into the ground. Gregarious parasites (*i.e.*, those of which two or more individuals can develop in one host) would have to distinguish hosts bearing a full complement of parasites from those not yet fully supplied. Preliminary experiments with *Microbracon* (*Habrobracon*) *brevicornis* Wesm., a gregarious parasite of Lepidopterous larvæ, suggest that it is able to do so.

589. A STUDY OF COLOUR AND COLOUR VARIATION IN *Aphis Gossypii* GLOVER. By R. E. WALL. (*Ann. Ent. Soc. Amer.*, 8, **3**, 1933, p. 425. Abstr. from *Exp. Sta. Rec.*, 70, **6**, 1934, p. 808.) The author has found extreme colour variation to be a constant feature in colonies of the cotton aphid, the variation being chiefly exhibited by the apterous forms which range from light yellow to blackish green. This characteristic is said to be useful in distinguishing the species. The account is presented in connection with a list of 37 references to the literature cited.

590. STUDIES ON *Platyedra gossypiella* SAUNDERS, THE PINK BOLLWORM OF COTTON IN THE PUNJAB. Pt. III. By M. A. Husain *et al.* (*Ind. Jour. of Agr. Sci.*, iv., **2**, 1934, p. 261.) *Summary: Platyedra gossypiella* moths exhibit positive phototropism in the Punjab. They may be trapped from about the middle of July to the first week of November, but the largest number collected during three years was from the middle of September to the middle of October. Four-hourly collections made on certain nights showed that the moths were attracted throughout the night, and that the period of the night when the greatest number were attracted varied with the season. It has been shown that the phototropic

response depends largely on temperature, and that the most favourable zone for attraction ranges from 76° to 87° F. There was greater attraction on nights following picking days than on nights following non-picking days. Moon appears to affect the phototropic activities of the moths. Moths of both sexes were collected at the trap, the number of females being slightly less than that of males. Dissection of the females showed that almost all of them were gravid. Examination of green bolls showed that the light trap, instead of reducing the intensity of attack in the field where it was placed, only served to increase it; it cannot, therefore, be recommended for the control of pink bollworm in the Punjab.

[*Cf.* Abstr. **76**, Vol. VI., and **617**, Vol. VIII., of this Review.]

591. UGANDA: *The Position with Regard to Pink Bollworm.* (*Uganda Herald,* 23/5/34.) At a meeting of the Central Plant Pests Board held in May, the position in regard to pink bollworm was reviewed. The Board were informed that, in order to retard the spread of the pest, the export of cotton-seed and seed cotton from infected areas had been prohibited, all cotton-seed in such areas had been destroyed or rendered innocuous, and fresh seed was being distributed for planting. The heat treatment of seed for planting was being investigated, and the need of a definite close season and the strict enforcement of the uprooting and burning order was stressed. Further points considered were the possible need for additional entomological staff to deal with the situation, the opening of the cotton-buying season at an earlier date in order to obtain a longer close season, and the advisability of extending the zoning system to other areas.

592. PINK BOLLWORM IN UGANDA. By L. R. Hancock. (*Uganda Herald,* 23/5/34.) Pink bollworm first appeared in Uganda in November, 1931. An account is given of the life-history of the pest, the districts infested, the amount of damage caused, and the measures of control advocated. Investigations are being continued to determine the resting period of the larvæ, alternative host plants, and possible control by means of parasites.

593. ÉTUDE SUR UNE MALADIE GRAVE DU COTONNIER PROVOQUÉE PAR LES PIQURES D'HÉLOPELTIS. By R. L. Steyaert and J. Vrydagh. (*Mem. Inst. Roy. Col. Belge,* Section Sci. Nat. et Med., i., **7**, 1933. Abstr. from *Rev. App. Mycol.,* xiii., **4**, 1934, p. 231.) A detailed account is given of the authors' extensive investigation of a disease of cotton marked by the formation of numerous depressed black stem cankers, which broke out with considerable severity at Kulu, Belgian Congo, in 1930, and reappeared a year later at Bomokandi and Bambesa. Experiments demonstrated that the disease, which was at first considered to be due to *Bacterium malvacearum,* had in fact resulted from injury by the mosquito bugs *Helopeltis bergrothi* and *H. sanguineus,* and the description of the effects produced by the insects on the stems indicates that there is a close similarity between these lesions and the cankers described by Smee and Leach on tea in Nyasaland as due to *H. bergrothi.* A few of the insects were observed in the course of these investigations to be parasitized by a species of *Sclerotium,* characterized by the formation of light to dark brown sclerotia, 48 to 100μ in diameter, with a cortex of brown cells surrounding an inner hyaline, thick-walled pseudoparenchyma. In culture the sclerotia were up to 140μ in maximum diameter.

594. ON THE BIOLOGY OF *Anagrus atomus* (L.) HAL.: AN EGG PARASITE OF THE LEAF-HOPPER *Erythroneura pallidifrons* EDWARDS. By E. I. MacGill. (*Parasitology,* xxvi., **1**, 1934.) *Anagrus atomus* (L.) Hal. is a mymarid parasite of the eggs of *Erythroneura pallidifrons* Edwards. The parasite is parthenogenetic, at any rate for the greater part of the year. Two larval stages are described. More than one egg may be laid in a single host egg, and these eggs may hatch, but only

one of the *Anagrus* larvæ reaches maturity. The development of *Anagrus atomus* takes about 16 days. The species is multivoltine.

595. REPORT OF THE CHIEF OF THE BUREAU OF ENTOMOLOGY, U.S.A., 1933. By C. L. Marlatt. (Abstr. from *Rev. App. Ent.*, xxii., Ser. A, **7**, 1934, p. 354.) From this report we quote the following in connection with the shipment of parasites: "*Microbracon brevicornis* Wesm., and *Pimpla* (*Exeristes*) *roborator*, F., readily attacked the pink bollworm in Texas, whence the former was sent in July to Mexico, where infestation of cotton occurs earlier. Small numbers of *M. mellitor*, Say, *M. platynotæ*, Cush., *Elasmus setosiscutellatus*, Cwfd., *Zatropis incertus*, Ashm., and *Perisierola* sp. were reared in the spring from *P. gossypiella* for the first time in Texas, largely from larvæ feeding in the flowers of cotton."

596. THE EFFECT OF TILLAGE ON ERADICATION OF COTTON ROOT ROT. By H. E. Rea. (*J. Amer. Soc. Agron.*, xxv., **11**, 1933, p. 231. Abstr. from *Rev. App. Mycol.*, xiii., **4**, 1934, p. 231.) Several tillage systems were compared for their relative efficacy in the control of cotton root rot (*Phymatotrichum omnivorum*) in widely separated sections of the Blackland Prairie region of Texas. Although the stand of host plants of the fungus—e.g., *Physalis mollis* and *Ipomœa trifida*—was reduced in proportion to the intensity and duration of the tillage treatments, the reductions in the incidence of root rot during the course of the experiments were not consistently parallel with the decline in the numbers of perennial weed hosts. It was evident that only a small percentage of the infection surviving the more drastic tillage operations was carried over on the live roots of such plants. Sclerotia maturing before the effects of the treatments could operate are thought to have been largely responsible for the perpetuation of the disease on the trial plots.

597. NORTH CAROLINA: *Plant Diseases*. (*N. Car. Sta. Rpt.*, 1932. Abstr. from *Exp. Sta. Rec.*, 70, **6**, 1934, p. 791.) Data are reported on the fungi causing damping-off of cotton seedlings, the treatment of seed with commercial dusts, and the correction of soil conditions causing black rust of cotton on Cecil sandy loam.

598. ULTRAVIRUS DISEASES OF PLANTS. By M. A. Beauverie. (Trans. title.) (*Ann. Serv. Bot. et Agron. Tunisie*, **9**, 1932. Abstr. from *Exp. Sta. Rec.*, 70, **3**, 1934, p. 344.) This article thoroughly reviews the modern literature on plant viruses, citing 762 articles. The host index lists mosaic diseases of 186 species in 33 families of plants. Other viruses, including curly top and infectious chlorosis, are listed in 67 species. The main economic viruses are discussed. Four theories have been proposed to explain the cause of virus diseases as follows: Filtrable viruses or ultraviruses, enzymes, protozoa, or bacteria. A comparative study of viruses is facilitated by ultrafiltration, chemical agents, electric currents, heat, and desiccation.

599. VIRUS DISEASES OF PLANTS. By J. Grainger. (Oxford Univ. Press, 1933. Abstr. from *Rev. App. Mycol.*, xiii., **4**, 1934, p. 253.) This book is intended as a simple textbook for the student of mycology or plant pathology, and contains mainly an account of the phenomena associated with virus diseases. The subject matter is arranged under chapter headings which include the following: the relations of a virus to its host, properties of the virus extract, the relations of insects to virus diseases, economic effects and control, and the classification and description of virus diseases. There is a bibliography of 445 titles.

600. BACTERIAL DISEASES OF PLANTS OCCURRING IN FORMOSA—I–III. By N. Okabe. (*J. Soc. Trop. Agr.* [Nettai Nogaku Kwaishi], iv., **4**, 1932; v., **1** and **2**, 1933. Abstr. in *Exp. Sta. Rec.*, 70, **3**, 1934, p. 345.) Angular leafspot of cotton, due to *Bacterium malvacearum*, is among the diseases dealt with.

601. "WILT" OF CULTIVATED BAST-YIELDING PLANTS UNDER CENTRAL ASIAN CONDITIONS. By A. A. Vassilieff. (In Russian.) (*Dis. and Pests of New Cultivated Textile Plants,* Inst. New Bast Raw Material VASKhNIL, Moscow, 1933. Abstr. from *Rev. App. Mycol.*, xiii., **6**, 1934, p. 369.) The results of experiments in 1932 in the neighbourhood of Namangan (Turkestan) to determine the host range of *Verticillium dahliæ* (stated to be the cause of a serious wilt of cotton in Russian Central Asia) showed that, when sown in plots which previously bore severely infected cotton plants, sesame, okra, soy-beans, hemp, and American jute were infected to the extent of 19·3, 85 to 93·5, 42·6, 24·2, and 98·2 to 100 per cent. respectively. The outward symptoms of the disease on these hosts were similar to those on cotton, but internally it was noticed that while in the cotton the internal mycelium was strictly confined to the vascular bundles in the stem, from which it did not emerge (except at wounds involving the vessels) even when cut cotton stems were kept for a long time in a moist chamber, in okra and American jute the mycelium often grew out through the walls and penetrated, both inter- and intra-cellularly, to the pith. In jute (*Corchorus capsularis*), which was also infected by the wilt, the mycelium passed from the vessels but did not extend beyond one or two cells. Isolations from the wilted plants mostly yielded *V. dahliæ*, which was culturally identical with the strain isolated from cotton; the latter was successfully inoculated into the other hosts through wounds. A careful selection of rotation crops is evidently necessary in infected land. *V. dahliæ* may well be also parasitic on a wide range of weeds.

602. GENETIC BASIS OF SELECTION PROCEDURE WITH COTTON WILT DISEASE. By T. Fahmy. (*Tect. and Sci. Serv. Bull. No.* 128. Min. of Agr. Egypt, 1934.) *Summary:* The behaviour of infection of the progenies of phenotypic, immune, resistant, and susceptible plants was studied with the following results:

A. (1) The progenies of phenotypic immune plants belonging to—

(i) Immune by susceptible cross;

(ii) Immune by heterozygous cross;

(*a*) Have in the F_3 totally immune or segregating families.

(*b*) The members of the totally immune families breed true to immunity.

(*c*) The phenotypic immunes of segregating families give in the F_4 generation totally immune families and segregating families, with the difference that in the F_4 generation there are proportionally more immune families than in the F_3 generation.

(*d*) In the case of the F_2 and F_3 generations of an immune by heterozygous cross, the percentage of phenotypic immunes is greater than in the respective generations of an immune by susceptible cross.

(2) In the selection made from successive generations of phenotypic immune plants originally from Sakha 4 it was possible to increase the percentage of immunity until some families gave total immunes in the fifth generation, but did not breed true in the sixth generation when grown under greenhouse infection; under ordinary infected field conditions, however, the isolated strain breeds true to total immunity for a number of successive generations, and can be considered as totally immune under ordinary infected field conditions.

B. The progenies of resistant plants.

(*a*) Progenies of resistant plants always segregate.

(*b*) Those belonging to immune by heterozygous cross give, as a whole, a higher percentage of phenotypic immunes than those of the same generation of an immune by susceptible, and where the

susceptibles are generally absent, contrary to those of the immune by susceptible where in the majority of the families susceptibles are present.

(c) Progenies of resistant plants of heterozygous strains such as Sakha 4 contain a smaller percentage of immunes than those of phenotypic immunes of the same variety (Sakha 4).

C. The progenies of susceptible plants.

Though susceptibility is recessive, the progenies of plants showing true susceptible symptoms do not in all cases breed true to total susceptibility, but generally segregate, giving a very high percentage of susceptible, and a small percentage of resistant and sometimes of phenotypic immune, indicating that there is in them an element of resistance which is still persisting.

D. There are two sources for selection of immune strains of economic value:

(a) From immune by susceptible or immune by heterozygous.

(b) From heterozygous strains with a high percentage of immunity. It is possible in this case by breeding successive generations from phenotypic immune to eliminate the susceptible element and to increase gradually the percentage of immunity, and in this manner to obtain a strain which behaves as totally immune on infected fields for successive generations, though it might (when grown on abnormally heavily infected soil, such as under greenhouse conditions) segregate, giving a very small percentage of resistant plants.

603. THE SELECTION OF WILT-IMMUNE STRAINS OF LONG STAPLE COTTON (SAKHA 4 GEDID). By T. Fahmy. (*Tech. and Sci. Serv. Bull. No.* 130., Min. of Agr. Egypt, 1934.) In Part I. the method of selection and in Part II. the history and characters of the selected strain are discussed. The following conclusions are presented by the author: " The selection for immunity led through successive breeding from (phenotypic) immune plants to the elimination, in the first generation, of the susceptible element, and to the gradual increase, during the generations raised, of the percentage of immunes until such time as the isolated family behaved as totally immune on very heavily infected fields. Though these families may give a small percentage of resistant plants under greenhouse conditions, they can, however, be considered as totally immune when grown even on abnormally highly-infected fields where Sakha 4 suffers from the disease to the extent of 14 per cent. The isolated strain can be safely propagated, for besides possessing superior resistance, it has higher yielding capacity and a lint equal to that of Sakha 4 in quality."

The bulletin is well furnished with illustrations and diagrams.

604. UN NUEVO MÉTODO PARA LA DETERMINACIÓN DE "LA MARCHITEZ" O "COTTON WILT" DEL ALGODONERO, EL MÉTODO DE LA HOJA O "COTTON WILT" LEAF INDEX. By T. B. Barducci. (*Min. de Fomento, Direcc. de Agric. y Gan., Estac. Exper. Agric. de la Molina Circ.* 21. Abstr. from *Rev. App. Mycol.*, xiii., **4**, 1934, p. 231.) A new method has been devised for distinguishing healthy cotton plants from those affected by wilt (*Fusarium vasinfectum*) in Peru, where selection for resistance to this destructive disease has already resulted in the development of the Tanguis variety. If a large leaf, situated half-way up the stem of a normal plant, be detached, the almost triangular scar at the base of the petiole will appear transparent and entirely green, whereas in the case of wilt infection one or more brown spots will be observed, formed by infected vessels close to the central cylinder. This method has numerous advantages, being extremely accurate (in 96·21 per cent. of the 2,000 leaves examined), simple, convenient, and rapid in practice. It is advisable to test three leaves from each

plant (from the upper, middle, and lower parts of the stem) in order to obtain absolute exactitude.

605. CONCERNING THE LENGTH OF INCUBATION PERIOD IN PHYSIOLOGICAL STUDIES OF BACTERIA. By P. L. Gainey and F. Briscoe. (*Soil Sci.*, xxxvi., **3**, 1933. Abstr. from *Exp. Sta. Rec.*, 70, **5**, 1934, p. 591.) Experiments showed that no differences in nitrogen-fixing ability were apparent after the customary incubations of from 1 to 3 weeks. When the incubation is restricted to a period of from 3 to 5 days only, "differences in nitrogen-fixing abilities, corresponding to differences in the number of *Azotobacter*, may be detected by the use of the plate method."

GENERAL BOTANY, BREEDING, ETC.

606. SCIENCE OF THE YEAR, 1933: THE BIOLOGICAL SCIENCES. By W. B. Brierley. (*Reprint received from the author.*) The usual useful and interesting summary of the work carried out during the year and the important results obtained in connection with Evolution and Genetics, Zoology, General Physiology, Botany, Microbiology and Disease. An outstanding feature of the year was the leading position of Russia in both theoretical and applied genetics. The principal event in 1933 was the Centenary Meeting of the Royal Entomological Society of London.

607. TEXTBOOK OF GENERAL BOTANY. By F. A. F. C. Went. (Gustav Fischer. Jena, 1933. Abstr. from *Exp. Sta. Rec.*, 70, **3**, 1934, p. 309.) A German-language edition of the author's Dutch textbook of general botany, intended not only for use in that field, but also for pharmaceutics, medicine, agriculture and chemistry. It presupposes a knowledge of the general fundamentals of physics and chemistry and an elementary knowledge of botany. Part I.—Morphology—includes chapters on cytology, histology, external morphology, developmental history (origin of primary tissues), secondary tissues, and experimental morphology. The chapters in Part II.—Physiology—take up the general characters of living substances, nutrition, respiration, growth, movements, and reproduction in its various phases. Subject and author indexes are provided, and selected bibliographies are given at the end of individual chapters.

608. THE ORIGIN OF CERTAIN OF OUR CULTIVATED PLANTS. By J. M. Hector. (*S. Afr. J. Sci.*, 30, 1933, p. 46. From *Plant Breeding Abstracts*, iv., **4**, 1934, p. 260.) A survey is given of the recent views on the origin of cultivated plants based on the published literature, with special reference to that emanating from Russia. The position with regard to cotton, maize, potato, and wheat (these being the plants of greatest importance for South Africa) is outlined.

609. ANATOMY OF THE TRANSITION REGION IN GOSSYPIUM. By A. M. Spieth. (*Bot. Gaz.*, 95, **2**, 1933, p. 338. Abstr. from *Exp. Sta. Rec.*, 70, **4**, 1934, p. 455.) The root-stem transition region of cotton is described from studies on the Dixie Triumph variety in comparison with Acala, Cleveland 54 and Delfos.

610. THE USE OF THE FIELD REFRACTOMETER IN PHYSIOLOGICAL AND BREEDING INVESTIGATIONS. By N. I. Orlovsky and B. I. Illinsky. (*Nauk. Zapiski Tsukr. Prom.* 34, p. 105, 1933 [Year 10]. From *Plant Breeding Abstracts*, iv., **4**, 1934, p. 275.) The Zeiss refractometer is recommended for determining drought resistance, cold resistance, and other such characters in breeding work. The use of the apparatus is described; and figures are given which show that varietal differences in these characters are associated with differences in dry matter content.

611. THE EFFECT OF NITRATE SUPPLY ON TRANSPIRATION RATIO IN PLANTS. By L. A. T. Ballard. (*Aust. Jour. Expt. Biol. and Med. Sci.*, ii., 1933, No. **3**,

p. 161. Abstr. from *Exp. Sta. Rec.*, 70, 3, 1934, p. 312.) The effect of nitrate in reducing transpiration ratio (ratio of water transpired to dry matter produced up to any point) is due not to an effect on the transpiration rate per unit weight of leaf, but to an effect on growth. This effect is such that at any point prior to that of harvest the ratio of the amount of dry matter produced after that point to the amount produced before it is, in most cases, greater as the nitrate supply increases. This causes a reduction in the transpiration ratio. The reduction is intensified by the fall with age in the transpiration rate per unit of plant, as a result of the fall in leaf weight ratio, for this has the effect of weighting the transpiration losses when the differences in percentage size, due to the growth phenomenon, are most marked. However, these reductions are partially, and in most cases more than, compensated for by an increase in the transpiration rate per unit of plant, as a result of an increase in the leaf weight ratio.

612. The Genetics of Cotton. By N. A. Malinovskii. (*Bull.* [*Trudy*] *ZakNIHI, No.* 36. Baku, 1933. From *Plant Breeding Abstracts*, iv., 4, 1934, p. 319.) Following upon introductory remarks on breeding methods in general, a brief outline is given of the history of cotton cytology, including reference to P.A. Baranov's five types of chromosomes, differing in form; cotton genetics is similarly reviewed, by reference to the most important literature on the subject, each character being taken in turn. Having dealt with the work done in other countries, the author turns to the achievements of the U.S.S.R. in cotton breeding. G. S. Zaitzev produced four long-stapled cottons, numbers 2017, 2005, 1838 and 1876, and effected a cross between *G. herbaceum* and *G. hirsutum*. This and a similar hybrid obtained later by the Azerbaijan Breeding Station were completely sterile. Interspecific hybrids of great interest have been made by S. S. Kanash.

The author calls attention to the comparatively small contribution made by Soviet workers to the subject, and deprecates the fact that so little advance has been made in any country in the genetics of quantitative characters, which are at the root of all the main agricultural qualities, and that so many characters have been studied in interspecific crosses without verification in crosses within the species.

An examination of the world collection of cottons has disclosed characters scattered throughout a very wide range of varieties. The Egyptian cottons have the best textile qualities, the Uplands the highest yields, whilst the Old World cottons possess characters such as extreme early maturity, high ginning percentage and resistance to wind damage, the latter being a quality of great moment for mechanized harvesting when only one picking is possible. The author recommends the method of " cyclic crossing "; for earliness all possible combinations between three types of parent, early, medium and late, should be made in the American cottons, involving 18 crosses, plus all combinations of two types of Egyptian (8 crosses) and of Asiatic cottons (8 crosses), thus involving 34 crosses in all. Other characters which are of importance and should be treated on similar lines are the following: size of seed, ginning percentage, lint length, fuzz, percentage shedding, resistance to wind damage, presence of petal spot, form of leaf lobe, and colour of pollen. The only way to accomplish this is by intensive collective work on the part of the three cotton-breeding centres.

The possibilities attaching to the methods of experimentally induced polyploidy and mutation are illustrated by reference to the results of various Soviet workers and to verbal communications of Ol'sanskii, who by the application of high voltage X-rays to germinating seeds obtained one plant whose bolls dehisced a month earlier than the controls. The author's own experiments with lower voltages, 50-70 kw. at a distance of 30 cm., have also shown that in this way a distinct alteration of the phenotype can be brought about, followed by abnormalities of meiosis in the plants produced.

Attempts are being made to produce polyploids from the adventitious buds which develop from the callus formed at the root collar on wounding. The excessive segregation which invariably occurs in later generations of American × Egyptian hybrids, which in the F_1's are so desirable in almost all characteristics, might be avoided if chromosome duplication could be induced in the F_1. In addition to regeneration, the influence of low temperature and narcotics is suggested as a possible way of inducing polyploidy. The wide segregation of interspecific hybrids is of value, however, in increasing the variability of the population, and with the same object in view a complete collection of the cottons of the world should be maintained.

613. THE GENETICAL CONCEPTION OF THE SPECIES. By S. C. Harland. (C.R. Acad. Sci., U.S.S.R., 1933. From *Plant Breeding Abstracts*, iv., **4**, 1934, p. 320.) Genetics and hybridization studies of *Gossypium hirsutum* and *G. barbadense* are described and evaluated from the evolutionary point of view. Both species, which belong to the New World species of Gossypium, are morphologically different, and have 26 chromosomes and a series of homologous characters. They interbreed readily, and the hybrids, with few exceptions, show normal chromosome pairing. The homologous characters, such as the presence or absence of the spot at the base of petals, within the species always show a close approximation to Mendelian segregation, whereas in interspecific crosses they exhibit typical "blending inheritance." This is explained by the author as being due to the basic genes for the homologous characters having, owing to a long separation through geological ages, become non-identical, and having evolved into new multiple allelomorphs, each accompanied by a specific modifier system, and consequently the homologous characters are genetically different. Hence, the author concludes, the first step in the evolution of a species is the production of new multiple allelomorphs which can be affected by new modifier complexes, thus rendering the building up of new characters possible through natural selection and modifiers. Further evidence for this hypothesis may be seen in the genetical behaviour of the crinkled mutant of *G. barbadense*, which, in crosses with *G. hirsutum*, gives F_1 intermediate and "blending inheritance" in F_2, but after seven back crosses, when transferred to a pure *hirsutum* background, and in further crosses with *G. hirsutum*, shows the normal monohybrid ratio and "blending inheritance" with *G. barbadense*.

According to the writer's conception of the genetic constitution of species, the modifier system represents an essential constituent of a species; also as a consequence of ecological differentiation the modifier systems have, by natural selection, developed different inherent structures in the two widely separated areas in which *G. hirsutum* and *G. barbadense* are found, and thus a new dominance mechanism has been formed. In this hypothesis the author differs from Fisher, according to whom the modifying genes are not of selective value on their own account, but because they improve a heterozygous mutation.

614. MEMOIRS OF THE COTTON RESEARCH STATION, TRINIDAD. (Pubd. by the Empire Cotton Growing Corporation. Price 2s. 6d. post free.) The eighth number of Series A, Genetics, has recently been issued, and contains the following paper reprinted from the *Jour. of Genetics*:

THE GENETICS OF COTTON. Pt. XI.: "Further Experiments on the Inheritance of Chlorophyll Deficiency in New World Cottons." By S. C. Harland. Further experiments are described on the mode of inheritance and distribution in six species of New World cottons of a pair of duplicate factors for chlorophyll deficiency. Duplication of factors is considered to have taken place through polyploidy, with subsequent mutation of one or other of the members constituting the pair in some of the species. *Barbadense* and *Darwinii* have become monomeric

through the loss of factor C_{hb}, while *purpurascens, hirsutum*, and *taitense*, when monomeric, are shown to have lost C_{ha}. The experimental data support Haldane's view that in polyploid species one member of a pair of duplicate genes may mutate without disadvantage, provided its functions can be performed by a gene in one of the other sets of chromosomes. The taxonomic and evolutionary significance of the results is discussed, and it is suggested that the extent to which the dimeric condition is converted to the monomeric in polyploid species may provide some indication of the age of the species. In an old series of allopolyploids, such as the New World species of *Gossypium* are considered to be, cases of dimery might be expected only infrequently, and usually only in interspecific crosses.

615. A NEW POSSIBILITY IN PLANT BREEDING. By M. Navaschin. (*Semenovodstvo*, 2, 1933, p. 11. From *Plant Breeding Abstracts*, iv., **4**, 1934, p. 281.) A direct application of parthenogenesis and androgenesis for breeding purposes is discussed in a popular form. These modes of reproduction would save considerable time in building up varieties and, owing to an entire absence of segregation, would make it possible to produce truly homozygous progeny.

616. NEUERE DATEN ZUR GENETIK DER PFLANZE. By H. C. Oppenheimer. (*Tab. Biol. Periodicæ*, **2**, 1932, p. 201. From *Plant Breeding Abstracts*, iv., **4**, 1934, p. 275.) Gives tables of the genera in which various phenomena have been reported, such as multiple factors, linkage, multiple allelomorphs, sex-linkage, polyploidy, allosyndesis in interspecific hybrids, reciprocal differences.

617. NEUERE KARYOLOGISCHE PROBLEME UND ERGEBNISSE. SAMMELREFERAT. II. ARBEITEN ÜBER BASTARDZYTOLOGIE. By H. Bleier. (*Z. Bot.*, **26**, 1934, p. 597. From *Plant Breeding Abstracts*, iv., **4**, 1934, p. 277.) A most useful general analysis, from the purely cytological standpoint, of the work that has been done on hybrids. An extensive bibliography is appended, while for the earlier literature and also for an excellent exposition of the relations between cytology and inheritance in species hybrids the reader is referred to Renner's monograph on species hybrids in plants.

618. LA CARIOLOGIA NELLE SUE APPLICAZIONI A PROBLEMI DI BOTANICA. By A. Chiarugi. (*Atti. Soc. Ital. Prog. Sci.*, **3**, Rome, 1932. From *Plant Breeding Abstracts*, iv., **4**, 1934, p. 277.) A knowledge of the number, size, shape, and behaviour of the chromosomes is of immense importance in the study of many problems of systematic botany, and especially in relation to the species problem and evolution. The author discusses the most important results already obtained in this connection.

619. A NEW GOSSYPIUM IN LOWER CALIFORNIA. By T. H. Kearney. (*J. Wash. Acad. Sci.*, **23**, 1933, p. 558. From *Plant Breeding Abstracts*, iv., **4**, 1934, p. 318.) The new species, found so far only on San Marcos Island in the Gulf of California, has been named *G. armourianum*. It is most nearly allied to *G. Harknessii*, and the features whereby it can be distinguished from this species are enumerated, together with a full description of the new species. It is highly xerophytic.

FIBRE, YARN, SPINNING, WEAVING, ETC.

620. IMMATURITY OF COTTON FIBRES IN RELATION TO THE POSITION OF THE SEED IN A LOCK AND THE LENGTH OF FIBRES. By R. Ayyar and R. L. N. Iyengar. (*Ind. Sci. Cong. Proc.*, **19**, Calcutta, 1932. Abstr. from *Exp. Sta. Rec.*, 70, **6**, **1934**, p. 768.) Factors influencing the production of immature cotton fibres were analyzed, with particular attention to the position of the seed in the lock and fibre length, and using two strains of Cambodia and one of Karunganni cotton.

A definite relation was noted between length of fibres and the proportion of

immature and ripe fibres, this relationship varying in direction with the type of cotton. Every increment in length did not produce equal increases or reductions in the percentage of ripe fibres. The distance from the pedicel end did not seem to bear any relation to the proportion of ripe and immature fibres, yet each seed in a lock acts as an independent distributing centre and produces a definite influence on the production of immature and ripe fibres. Group lengths appeared to induce greater variation in the distribution of ripe fibres than position of the seeds, while it is the positions that contribute to the greater variability in the percentage of immature fibres in Cambodia cotton. A definite interaction between the position of the seed and the length of fibres seemed to influence the proportion of immature fibres borne on the seed.

621. FIBRE MIXTURES: ANALYSIS. American Society for Testing Materials. (*Proc. A.S.T.M.*, xxxiii., **1**, 1933, p. 931. Abstr. from *Summ. of Curr. Lit.*, xiv., **11**, 1934, p. 293.) A "tentative standard" scheme is detailed for the identification of the complete range of common fibres, hairs, and bristles, and for the determination of moisture, non-fibrous material (*e.g.*, "total size"), cellulose acetate rayon, silk, regenerated cellulose rayon, cotton and wool in textiles containing two or more of these materials.

622. VARIATION IN THE PHYSICAL PROPERTIES OF FIBRES SITUATED IN THE DIFFERENT REGIONS OF THE SEED-SURFACE. By R. L. N. Iyengar. (*Ind. Sci. Cong. Proc.*, **19**, Calcutta, 1932. Abstr. from *Exp. Sta. Rec.*, 70, **6**, 1934, p. 768.) Determination of length, weight per centimetre, and immaturity of fibres pulled from six regions of the surface of seeds of seed cotton showed that the micropylar end contained fibres shorter than other portions, had the greatest fibre weight, a high percentage of ripe, and few dead and thin-walled fibres. The chalazal end had a very low fibre weight and a high percentage of dead fibres. No great variations were noted in the other regions.

623. COTTON HAIR: FINENESS DETERMINATION. By T. L. W. Bailey. (*Text. Mercury*, **90**, 1934, p. 434. Abstr. from *Summ. of Curr. Lit.*, xiv., **11**, 1934, p. 292.) An abstract of a paper read before the Cotton Committee of the American Society for Testing Materials, describing methods used at the Bureau of Agricultural Economics for determining fibre fineness and maturity. Fineness is determined by counting and weighing whole fibres of known length from groups of the length array differing in length by ⅛ inch. The results are expressed as mean weight per inch. An index of fibre maturity is obtained by treating fibres with 18 per cent. caustic soda, and examining under a microscope. Thick-walled fibres appear as smooth rods, while thin-walled fibres appear quite convoluted. The fibres are classified into three degrees of maturity or fibre-wall development, and counted in groups of 100 fibres for each length in the length diagram.

624. COTTON HAIR: STRENGTH DETERMINATION. By H. B. Richardson. (*Text. Mercury*, **90**, 1934, No. 2357, p. xi. Abstr. from *Summ. of Curr. Lit.*, xiv., **11**, 1934, p. 292.) An abstract of a paper read before the Cotton Committee of the American Society for Testing Materials, dealing with improvements in the Chandler bundle method for determining the strength of bundles of cotton fibres. The size of the bundles tested must be specified, and strength is expressed in terms of the area of cross section of pure cellulose. The threads must be allowed to come together at the centre of the bundle, and the combing method should be accurately specified.

625. COTTON HAIR: TESTING. By A. Lesouef. (*Bull. Soc. Ind. Rouen*, **61**, 1934, p. 337. Abstr. from *J. of Text. Inst.*, xxv., **6**, 1934, A302.) It is pointed out that the classification of cotton by different graders may show considerable variation, and that laboratory tests are more reliable than the methods used by

the graders. Methods of determining length (Baer diagram), fineness, strength, etc., are briefly described and some typical results are discussed.

626. Cotton Hairs: Width and Swelling. By K. Küsebauch. (*Textilber.*, **15**, 1934, p. 193. Abstr. from *Summ. of Curr. Lit.*, xiv., **12**, 1934, p. 317.) Observations of the swelling of cotton hairs under specified conditions are useful in determinations of the quality and origin of cottons. A bundle of hairs is prepared from the raw cotton or yarn to be tested, and is cut into two; one section is immersed in glycerin and the other in Molisch's solution (2 parts caustic potash of 30° Bé. and 1 part 25 per cent. ammonium hydroxide solution), and the diameters of the hairs are measured with a microscope. The swelling in the Molisch solution is measured by the difference in diameters in the two cases, and a swelling standard value is calculated from the arithmetic and geometric means of the width measurements in the two solutions. The results of tests on Egyptian, American, and Indian cottons are given. The increase in diameter on swelling is generally greater the finer the cotton. This increase, considered in relation to maturity, gives an indication of the mercerizing and dyeing properties of the cotton. The swelling standard value increases with decreasing fineness of the cotton, and may be used as an aid to the determination of the origin of cotton.

627. Origin of Lint and Fuzz Hairs. By R. Ayyar and G. S. Iyengar. (*Ind. Sci. Cong. Proc.*, **19**, Calcutta, 1932. Abstr. from *Exp. Sta. Rec.*, 70, **6**, 1934, p. 768.) Examination of microtome sections of cotton ovules of different ages revealed that formation of lint cells is predetermined, and that differentiation in the epidermal cells occurs even 16 hours before the flower opens. The rate of development of these cells varies with their location in the peripheral layer of the outer integument. Crops of hairs continue to be produced even after flowering. A second kind of hairs, evidently produced from the subepidermal layer 12 days after flowering, appears to correspond to the fuzz of the mature seed.

628. Cotton Mill Waste: Analysis. By C. D. Honiker. (*Cotton* [U.S.], **98**, 1934, **4**, p. 45. Abstr. from *Summ. of Curr. Lit.*, xiv., **12**, 1934, p. 317.) Tables are given showing the maximum and minimum waste from moisture, sand and dirt, parts of bolls, leaves, stems, etc., fibres with neps and kinks, short fibres and dust, thread and cloth, and sweepings during several years' work in an American mill.

629. Neps and Similar Imperfections in Cotton. By N. L. Pearson. (*U.S. Dpt. Agr. Tech. Bull.* 396, 1933. Abstr. from *Exp. Sta. Rec.*, 70, **4**, 1934, p. 574.) Small imperfections in ginned cotton lints, slivers, rovings, and yarns are classified as neps proper, fragments of seed coat (fragments of mature seeds and motes), knots formed by fibres entangled around bits of foreign matter or small seed coat fragments, fragments of compressed brittle fibre masses, and fragments from dried diseased areas. The neps proper consist only of entangled fibres, 15 kinds being differentiated according to the type or types of fibres in the knot, which are classified as thick-walled, medium-walled, thin-walled, and fuzz fibres.

In most samples studied, thin-walled fibres entered into the most neps, thick-walled fibres into the least, and neps with medium-walled or fuzz fibres were intermediate in number. The thin-walled fibre is deemed the most important fibre type in nep formation. The proportion in which various fibre types occur on the seed and other seed cotton properties seemed to influence the number of neps developing during ginning and spinning. Neps appeared to increase during manufacture. Neps occurring in ginned cotton, and those found in products of manufacturing processes, did not differ essentially in composition. The fibres in neps do not seem to be entangled in any definite manner. Large neps usually

are an irregular tangled mass of fibres, whereas small neps often possess a definite central knot.

630. RAW COTTON: TESTING. By C. M. Conrad. (*Text. Mercury*, **90**, 1934, p. 434. Abstr. from *Summ. of Curr. Lit.*, xiv., **11**, 1934, p. 293.) States the advantages which might follow from the development of adequate standards for characters such as strength, cohesiveness of fibres, fibre elasticity and pliability, fibre fineness, uniformity of fibre dimensions, capillarity and porosity of the fibre substance, fibre maturity and fibre durability. Adequate standardization would gradually replace spinning tests by less expensive processes and would improve both the marketing process and the quality of American cotton.

631. COTTON SPINNING MILL: RATIONALIZATION. By K. W. Mahlen. (*Spinn. u. Web.*, 52, **7**, 1934, p. 1. Abstr. from *J. Text. Inst.*, xxv., **5**, 1934, A225.) Various improvements in technique are described, and the importance of temperature and humidity control is pointed out.

632. COTTON YARN: STRENGTH DATA ANALYSIS. By M. E. Campbell. (*Text. Mercury*, **90**, 1934, p. 434. Abstr. from *Summ. of Curr. Lit.*, xiv., **11**, 1934, p. 294.) Points out the need for a sound system of analysis for use in interpreting spinning test results, particularly as regards cotton yarn strength. A brief general discussion of the effect of variability of data upon the reliability of an average is followed by a description of a statistical test for significance between means. Actual spinning test results are presented to show that the corrected skein strengths for a particular cotton and count and twist of yarn are normally distributed, and are thus adapted to the application of Fisher's method. A practical system for applying this method to yarn strength data is described, involving the calculation of the standard errors of the means, and of the differences between the means, from which the probabilities that the differences are due to chance alone are determined. This method can also be applied to other types of textile research data.

633. ANALYSIS AND TESTING OF COTTON. By M. Caine. (*Text. Rec.*, lii., **614**, 1934, p. 18.) The instruments required and procedure to be adopted for making the cotton stapling test, determining the maturity of cotton and the hair weight per centimetre, are discussed.

634. A PROGRAMME FOR COTTON. (*Text. Weekly*, xiii., Nos. 325, 327, 331, 1934.) Pt. III.: The Effect of Past Monetary Policy on the Industry. Pt. IV.: Is Pre-war Machinery Obsolete ? Pt. V.: Obsolete Methods.
[*Cf.* Abstr. **480**, Vol. XI., of this Review.]

635. A SURVEY OF SPECIAL LOOMS OF BRITISH ORIGIN. By J. Starkie. (*Text. Weekly*, xiii., **330**, 1934, p. 468.)

636. THE WORLD TEXTILE INDUSTRY. By Dr. A. Niemeyer. (*Text. Rec.*, lii., **614**, 1934, p. 20.) A critical survey.

637. ANCIENT PERUVIAN FABRICS: DESIGN. By G. Tagliani and A. Wiazmitinow. (*Textilber*, **15**, 1934, p. 257. Abstr. from *Summ. of Curr. Lit.*, xiv., **14**, 1934, p. 360.) The production of multi-coloured fabrics in ancient civilizations is discussed, and illustrations are given of examples made by the Incas of old Peru. Investigations of the nature of the dyes and mordants used, and their probable origins, are briefly described.

LEGISLATION.

638. NYASALAND: *The Cotton Ordinance*, 1934. An Ordinance to secure and maintain the production of the highest quality of cotton, and in general to regulate and control the cotton industry, includes provisions for the control of

distribution and use of cotton-seed, and of the export of raw cotton; for the establishment of cotton-buying centres; and for the issue of licenses for cotton buying, and ginning and baling.

639. TANGANYIKA TERRITORY: *Cotton (Fees) Rules,* 1934. *Government Notice No.* 51 (April 27, 1934), states the fees payable for the year ending 31st March, 1935.

Cotton (Amendment) Rules, 1934. *Government Notice No.* 58 (May 21, 1934) provides for the insertion of a new rule after rule 12A.

640. PINK BOLLWORM QUARANTINE IN THE UNITED STATES OF AMERICA. (*Agr. and Livestock in India,* iii., **6**, 1933, p. 612.) *Pink Bollworm Quarantine No.* 5 (Revision of Quarantine and Regulations), issued by the Bureau of Plant Quarantine of the United States Department of Agriculture, October 26, 1932, adds six counties of north central Florida to the regulated areas, and makes provision for the compression of cotton lint and the crushing of cotton-seed produced or ginned therein.

MISCELLANEOUS.

641. THE BRITISH COTTON INDUSTRY. (*Text. Weekly,* xiii., **330**, 1934, p. 459.) The report of P.E.P. (Political and Economic Planning) on the present structure of the British cotton industry has recently been issued. Part I. is an introduction containing an analysis of the causes of the trouble in the industry, and the facts of the situation as it is already known to exist to those in the trade; Part II. contains a detailed survey of the various sections which comprise the cotton industry; Part III. contains the reorganisation proposals; Part IV. is a summary of the characteristics, developments, and progress of the cotton industry in other countries.

642. TEXTILE RECORDER YEAR BOOK, 1934. The statistical data, tables of production, etc., which form a prominent feature of the volume, have been brought up-to-date and revised where necessary. New matter, to the extent of some fifty pages, is included. The sections on Cotton Buying and Selling and Systems of Spinning of the Worsted Industry have been entirely rewritten, whilst among the new articles mention may be made of those dealing with Wool and Mildew and the Lubrication of Textile Machinery. A list is also included of new textile companies registered during 1933, together with particulars as to their activity, capital, directors, etc.

643. INDUSTRIAL LEADERSHIP. By A. P. Young. (*J. Text. Inst.,* xxv., **5**, 1934, p. 69.) The Textile Institute's "Mather" lecture. The subject is dealt with under the following heads: A Survey of the Past; The Dawn of a New Era; The Second Industrial Revolution; The Power of Industrial Leadership; Whither Industrial Leadership ? with special reference to the textile industry.

PERSONAL NOTES

APPOINTMENTS.

Mr. J. Marshall, the holder of a special Studentship last year, has been appointed by the Corporation as an Assistant at the Cotton Breeding Station, Barberton, in connection with the work on insect pest control.

Mr. N. M. Wight, a former holder of a Studentship, has received an appointment as an Agricultural Officer under the Department of Agriculture, Tanganyika Territory.

OFFICERS ON LEAVE.

When an officer of a colonial Department of Agriculture (or of the allied departments of Irrigation, Transport, etc.) comes "home" on leave, he usually brings with him much information that may be of considerable value to similar officers in other colonies, or to the officers of the Empire Cotton Growing Corporation, who have to collect, collate, and use all possible information relating to cotton. The Corporation would consequently much appreciate the courtesy if Directors of Agriculture and others would be so kind as to inform them, in advance if possible, of the names, probable addresses, and approximate dates of arrival in England of officers coming on leave. This would give the Corporation the opportunity of getting into touch with these officers themselves, and of giving the latter the opportunity of meeting with one another. A further courtesy would be conferred if the officers themselves, upon arrival, would call at, or inform, the offices of the Empire Cotton Growing Corporation, which are at the corner of Millbank and Wood Street (entrance by the first door in Wood Street), immediately opposite the offices of the Crown Agents for the Colonies.

At the date of writing the following officers are on leave, or will shortly be arriving in England, from cotton-growing countries:

British Guiana	Mr. H. Macluskie.
,, ,, ...	Mr. E. B. Martyn.
Ceylon	Mr. C. N. E. J. de Mel.
,, ...	Mr. J. C. Hutson.
,, ...	Mr. E. J. Livera.
Fiji	Mr. H. R. Surridge.
Gold Coast	Mr. B. T. Steemson.
,, ,, ...	Mr. J. T. H. Stein.
Kenya Colony	Mr. G. H. G. Jones.
,, ,, ...	Mr. R. N. Noble.
,, ,, ...	Mr. C. O. Oates.
,, ,, ...	Mr. C. L. Silvester.
,, ,, ...	Mr. C. A. Thorold.
Nigeria	Mr. B. G. Owen.
,, ...	Mr. J. H. Palmer
,, ...	Mr. J. B. G. Savory.
,, ...	Mr. A. Sheffield.
,, ...	Mr. J. R. V. Smyth.
,, ...	Mr. R. M. Steven.
,, ...	Mr. W. G. Watson.
Northern Rhodesia	Mr. C. J. Lewin.
Sierra Leone	Mr. F. C. Deighton.
Tanganyika Territory	Mr. B. D. Burtt.
,, ,, ...	Mr. C. B. Garnett.

Tanganyika Territory	Mr. C. Harvey.
,, ,, ...	Mr. F. M. Rogers.
,, ,, ...	Mr. A. H. Savile.
,, ,, ...	Mr. A. S. Stenhouse.
,, ,, ...	Mr. A. Young.
Uganda	Mr. W. J. Badcock.
,, ...	Mr. H. Hargreaves.
,, ...	Mr. E. G. Staples.
,, ...	Mr. A. S. Thomas.
,, ...	Dr. J. D. Tothill.
Zanzibar	Mr. A. J. Findlay.

The following officers of the Corporation's staff abroad are also on leave in this country:

Nigeria	Mr. A. E. Casement.
Nyasaland	Mr. H. C. Ducker.
South Africa	Mr. F. R. Parnell.
,, ,, ...	Mr. F. S. Parsons.
West Indies	Dr. E. Phillis.
,, ,, ...	Dr. A. Skovsted.

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